

Dear Colleague:

LIVING COLLECTIONS  
Summer, 2003

Enclosed please find sample narratives, schedules of completion, and summary budgets from four successful applications from the 2003 IMLS Conservation Project Support (CPS) grant competitions.



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of MUSEUM  
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SERVICES

The attached samples were selected because they demonstrate how individual institutions with different conservation needs successfully developed projects that address those needs. We feel these narratives are logically and clearly presented, and give sufficient information to support the request.

This packet contains four samples that represent different types of conservation projects. They emphasize the overall institutional conservation perspective, the involvement of conservation professionals in all phases of the project, and the importance of the project as the highest institutional priority for collections care.

In addition, there are three samples of funded education components. We hope that these samples give you the impetus to partner with your staff educators to develop your own creative way to educate the general public about your conservation project.

The samples included in this packet are listed on the back of this letter. No endorsement by IMLS of any personnel, conservation facilities, private firms, or conservation procedures and methods identified in the narratives should be assumed.

I hope that these sample narratives will be useful to you as models for structuring a proposal for your conservation needs. IMLS Office of Museum Services program staff is available at (202) 606-8539 or [imlsinfo@imls.gov](mailto:imlsinfo@imls.gov), and will be happy to discuss any questions you have as you develop your proposal.

The application deadline for the 2004 Conservation Project Support grant program is:

**October 15, 2003**

Applications for CPS are available from the IMLS Web site ([www.imls.gov](http://www.imls.gov)), or by calling us at 202-606-8539. We look forward to receiving your application.

Sincerely,

Mary Estelle Kennelly  
Associate Deputy Director for Museum Services  
IMLS

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**Sample Conservation Projects: Living Collections**

<u>Project Type</u>	<u>Museum</u>	<u>State</u>	<u>Award</u>	<u>Match</u>	<u>Project</u>	<u>Budget</u>	<u>Discipline</u>
*Detailed Survey	University of CA, Davis Arboretum	CA	\$10,000	\$46,392	\$56,392	\$687,707	Arboretum
Environmental Survey	Denver Botanic Garden	CO	\$40,069	\$66,360	\$106,829	\$10,955,183	Arboretum
Research	North Carolina Aquarium/Roanoke	NC	\$49,800	\$68,805	\$128,580	\$2,600,000	Aquarium
Research	Zoological Society of San Diego	CA	\$41,344	\$60,080	\$101 ,424	\$148,715,945	Zoo

\*also has sample education component

**Sample Education Components:**

<u>Museum</u>	<u>State</u>	<u>Education Award</u>	<u>Total Grant Award</u>
Oregon Zoo	OR	\$9,997	\$50,960
University of California, Davis Arboretum	CA	\$10,000	\$46,392
Weatherspoon Art Museum	NC	\$4,247	\$49,711

# **University of California, Davis Arboretum**

Davis, California

Project Type: Detailed Condition Survey

IMLS Award: \$46,392 (includes \$10,000 for education component)

Match: \$48,111

Total Project: \$94,503

Museum Budget: \$687,707

## NARRATIVE QUESTIONS-CONSERVATION PROJECT

### 1. WHAT IS THE DESIGN OF THE PROJECT?

The proposed project is a detailed survey of the condition of the oak collection of the University of California Davis Arboretum, including environmental conditions and status of individual specimens. The goals of the project are to document current conditions and determine appropriate corrective treatment and/or changes to current maintenance practices necessary to safeguard the health of the collection. In particular, we will examine the collection for evidence of Sudden Oak Death, a disease caused by the pathogen *Phytophthora ramorum*, which has reached epidemic proportions in the coastal areas of California. In order to meet these goals, we will contract with John Lichter, MS, consulting arborist, who will carry out a detailed assessment of the oak collection in conjunction with Arboretum staff, students, and volunteers. Project components will include:

- Detailed documentation of current maintenance and conservation practices, such as irrigation, pruning and pest control schedules, to provide baseline data. This will be accomplished through interviews with maintenance personnel and examination of maintenance records.
- Visual analysis of soil characteristics. Soil sampling pits will be dug to a depth of at least three feet in multiple locations throughout the oak grove. Qualitative data on rooting, soil texture, color, organic matter and density will be collected.
- Laboratory analysis of soil chemistry, texture, and bulk density. Soil within sampling pits will be collected for analysis to determine chemical limitations. Measurements will include pH, electrical conductivity, saturation percentage, levels of calcium, magnesium, sodium, chloride, and boron, sodium adsorption rate, and exchangeable sodium percentage. A mechanical analysis for soil texture will determine percent by weight of sand, silt, and clay. Bulk density, a measure of soil compaction, will be calculated by weighing soil samples of a known volume.
- Water audit to evaluate current irrigation system and practices. A grid of uniform catch cans will be installed on fifteen-foot spacing to identify irregularities in coverage and distribution. Results will be charted on a gridded map and correlated with tree condition and infiltration rates.
- Soil moisture and infiltration rate monitoring. The rate at which water penetrates the surface of the soil will be measured with ring infiltrometers adjacent to each of the sampling pits. Soil moisture will be tracked with a series of in-ground electronic monitors.
- Assessment of individual specimen condition, structure, and pathology. Each individual tree will be examined visually to identify visible signs of stress, pest damage, or pathogens and to document the need for corrective pruning or other structural treatment.
- Laboratory testing for pathogens. When symptoms are observed, tissue samples will be collected and analyzed to identify the pathogens involved.
- Data analysis, discussion, and recommendations for management and corrective treatment.

The project will be carried out over a five-month period during the dry summer season, from May through September 2003. This will allow monitoring of irrigation practices under drought conditions. At this time deciduous specimens will be in leaf so pathogens will be more easily observable. The total amount of time that we estimate for this project is 972 hours. Of these, 152 will be consultant hours, 720 will be Arboretum staff time, and 100 will be volunteer hours. We believe that this is a reasonable amount of time to allocate for an evaluation of more than 300 trees and an environmental assessment of the 7.5 acre grove.

The final product of this project will be a written report including all data collected, analysis and recommendations for treatment. A discussion of the project and an abstract of the report will be published in the Arboretum's quarterly Review.

Care will be taken to protect the trees in the oak collection during the conservation activities. Trucks and other heavy equipment will be confined to gravel roadways to avoid soil compaction. Excavation will be limited to several discrete sampling pits and will be carried out either by hand or with an air spade, to minimize damage to tree roots. Tissue sampling will be conducted only when the presence of pathogens has been confirmed visually. Routine maintenance activities will continue on the normal schedule during the project.

## **2a. WHAT ARE THE PROPOSED CONSERVATION METHODS AND WHY ARE THEY CONSERVATIONALLY SOUND?**

The University of California, Davis is one of the most prominent plant science research and teaching institutions in the world. The Arboretum strives in all its operations to reflect the excellence of the University, and to make use of the most current research and thinking in the field. John Lichter, our conservation consultant, teaches in the Department of Environmental Horticulture and Urban Forestry and at UC Davis, serves on the board of the American Society of Consulting Arborists, and chairs the Research Committee of the International Society of Arboriculture Western Chapter; his work keeps him abreast of the latest findings.

The assessment techniques that will be used to evaluate the specimens in the oak collection and their environmental conditions (described in Section 1, above) are established practices in the fields of arboriculture, horticulture, and environmental management. We tested a range of evaluation techniques in a similar, although smaller-scale, assessment of the Arboretum's redwood grove, and have determined that the procedures proposed here are the most efficient and yield the most valuable data.

All work done at the University of California is subject to stringent safety requirements. All Arboretum staff, students and volunteers are safety-trained and must be tested and cleared before handling power tools, vehicles, or heavy equipment. Precautions to ensure the safety of the collection are addressed elsewhere in this document.

## **3. WHAT ARE THE SPECIMENS THAT ARE THE FOCUS OF THIS PROJECT?**

The oak collection of the UC Davis Arboretum includes 398 specimens representing 131 taxa (species, subspecies, and hybrids). These include species from a wide geographic range, with an emphasis on arid-climate oaks from California, the western U.S., Mexico, and the Mediterranean basin. Most of these trees were grown from acorns collected in the wild, and the Arboretum curatorial records include information on where, when, and by whom they were collected and a detailed description of the site, conditions, and associated species of their native habitat. The collection also includes 30 artificial hybrids developed by Dr. Walter P. Cottam of the University of Utah.

The oak collection is the most prominent taxonomic collection at the UC Davis Arboretum in terms of number of specimens and size (acreage) of display, and is probably the most scientifically significant collection. The oak collection supports all of the seven stated goals of the Arboretum (see page 7.12); it is used extensively as a resource for the teaching and research activities of the University, for public education and outreach, as a demonstration of regionally-appropriate horticulture, and for recreation.

The oak collection and other taxonomic collections at the UC Davis Arboretum were formed to support the teaching and research functions of the University, and remain an important resource for researchers and educators. Due to the difficulty of obtaining living research materials from a broad sample of geographically distant plants within a taxonomic group, complex genetic, biochemical and ecological studies are often conducted on very limited research samples. The Arboretum's

collection of slowly-maturing but long-lived oak species and the extensive documentation maintained on individual specimens are thus invaluable to scientists.

Recently, the oak collection has played a role in the fight against the devastating epidemic of the Sudden Oak Death pathogen now affecting wild oaks in California. Dr. David Rizzo, identifier of the pathogen and a member of the California Oak Mortality Task Force, the statewide scientific effort to develop methods of control, has conducted research on specimens in the Arboretum collection.

Sizeable collections of mature oaks are uncommon in botanic gardens due to space restrictions, the difficulty of propagating oaks vegetatively, their propensity for hybridizing, perishable seeds, and the fact that they may take decades to reach reproductive maturity. The nation's most prominent collections of oaks are at arboreta of the east coast and the Pacific northwest. Many of the oaks of the arid southwest and subtropical Central America are not tolerant of moisture or cold-hardy enough to grow in these climates. The UC Davis Arboretum is the only institution in the southwestern United States with a large collection of mature oaks, and the collection is particularly strong in species from arid climates.

The oak collection provides information on the ability of various species to thrive in the Mediterranean-type climate of California's Central Valley. The collection is a resource for introducing oaks of extraordinary horticultural merit into cultivation.

The Arboretum oak collection includes specimens of several taxa identified as rare or of concern. Documenting propagation methods for these plants, displaying them to educate the public about their status, and encouraging their use in cultivation are all part of our efforts to ensure their continued survival.

Some specimens in the oak collection are also historically significant. Several massive valley oak trees, now accessioned as part of the Arboretum collection, served as boundary markers for the Laguna de Santos Calle Mexican land grant and appear on the earliest maps of this area.

#### **4. HOW DOES THE PROJECT RELATE TO YOUR MUSEUM'S ONGOING CONSERVATION ACTIVITIES?**

Responsibility for the routine maintenance of the UC Davis Arboretum collection is held by the Arboretum Superintendent and the Collection Development Manager. Garden inspections, attended by the superintendent, landscape manager, and groundskeepers are made on a weekly basis and generally cover a single Arboretum collection or garden. A detailed list of tasks to be completed is drawn up to serve as a record of the inspection, a work list for the garden groundskeeper, and later as a checklist for completed work. This simple but effective management tool allows senior staff to evaluate the condition of the specimens over a period of time and advise on horticultural procedures to properly maintain them. We recently developed a prototype maintenance tracking system using a scheduling database and a hand-held computer, which will allow data to be entered in the field.

Strict departmental and campus regulations control pesticide and chemical use in the Arboretum. Our Integrated Pest Management (IPM) program helps conserve important plants within the collection without adversely affecting research underway in the Arboretum.

The collection inventory is a relational database linked to a set of electronic maps. Computers are backed up on a daily basis; backup sets are rotated to ensure that data accidentally destroyed can be recovered. Copies of plant records in both printed and electronic form are maintained off-site to reduce the risk of destruction by fire or other causes.

Periodically, as funding allows, we conduct detailed horticultural and curatorial evaluations of the collections. In 1988, a general survey of the conservation needs of the California native plant

collection was completed. This survey, funded in part by the IMLS, allowed us to establish a prioritized Long Range Conservation Plan for the California native plants included within our collection. During the following three years, with this long-range plan in hand, we successfully completed over \$100,000 worth of conservation activities with most activities funded by matching grants from other organizations. In 1992, with additional funding from IMLS, we developed a Conservation Monitoring System for our California Native Plant Collection, in which the data previously gathered in the conservation survey on the conservation needs of individual specimens is linked to the computerized maps and data base. All plants requiring a particular conservation treatment can be highlighted on a map and seen at a glance. The value of this system for routine garden inventorying, cataloging, and records maintenance is profound.

In 1999, we participated in assessments under both the MAP and CAP programs. The CAP assessment, conducted by Linda McMahan, Director of the Berry Botanic Garden, addressed critical strategic needs of the institution with an analysis of general museum systems, and highlighted the importance of increasing horticultural staff and planning for collection development (see Executive Summary, attached). The MAP assessment was conducted by Nancy Morin, Director of the Arboretum at Flagstaff and former Executive Director of the American Association of Botanical Gardens and Arboreta. She concluded that "[t]he collections represent priceless local, regional, national and international resources. They are a community investment, and support must be given for their long-term curation."

Also in 1999, we completed a detailed curatorial analysis of our oak collection and compiled records on the value and significance of the collection, the history of collection development, an inventory of the collection, maintenance, interpretation, and funding status. We then prepared detailed recommendations for additions to and conservation of the collection (see Final Recommendations, attached). The proposed project is a first step toward implementing the recommendations of the curatorial analysis.

We have identified the oak collection as the most in need of detailed conservation assessment and treatment for three major reasons. First, the Arboretum has been invited to apply for inclusion of the oak collection in the North American Plant Collections Consortium. According to our MAP assessment, "The Davis Arboretum Oak Collection almost certainly would be accepted into the NAPCC. This would bring broader use and greater recognition to the collection and to the Arboretum." Participation in NAPCC requires a significant commitment on the part of the institution including "developing, documenting, verifying, maintaining, sharing, propagating, and dissemination~the plant collection." A detailed conservation analysis would provide the basis for the conservation activities necessary for adding the oak collection to the Consortium. Secondly, the devastating spread of the Sudden Oak Death (SOD) pathogen in wild oaks in California makes clear the need for diligent monitoring and protection of important oak specimens in botanical garden collections (see USDA Pest Alert, attached). Finally, we have received a generous endowment to support the conservation and development of the oak collection from Dr. John Tucker, who led the development of the collection in the 1960s. The endowment will begin to produce income in about four years. The proposed collection assessment will lay the groundwork for further development and continue< care of the collection.

The Arboretum has made a significant institutional commitment to the conservation of the collections. Our 1998 Strategic Plan identified increasing the size of the horticultural and curatorial staff as a critical need. Since then we have successfully advocated for full-time, permanent funding for the Curator and Collection Development Manager positions, and have added two full-time positions, Horticultural Curator and Nursery Manager, as well as a part-time Assistant Curator and additional student gardeners. We have also improved our coordination with the campus Grounds Division and advocated for significant increases in in-kind donations of labor, equipment, and special services from the Grounds staff.

Our Curator, Horticultural Curator, and Collection Development Manager have made it their primary project this year (2002-03) to document and standardize horticultural maintenance schedules and practices for the entire collection. This is part of the process of transition as we prepare for the retirement of the Arboretum Superintendent after more than 30 years on the job. We are attempting to "download" the tremendous amount of information he carries in his prodigious memory.

We have a special commitment to conserving the oak collection because of its value to researchers. Our Horticultural Curator conducted the curatorial analysis of the oak collection mentioned above to prepare us for an extended conservation effort. We have received two grants from the Elvenia Slosson Fund for research on vegetative propagation of oaks. Our Nursery Manager is working with prominent oak experts to investigate propagation methods such as tip cuttings, stump sprout cuttings, hedging (severe pruning to encourage sprouting), etiolation (excluding light to promote tender growth), and grafting. This work is designed to identify methods of cloning individual oaks that demonstrate desirable characteristics such as disease resistance or unusual form.

## **5. WHAT ARE THE ANTICIPATED BENEFITS OF THE PROJECT?**

This project will provide the basis for future conservation activities to safeguard the Arboretum's oak collection. Besides providing extensive data, a professional analysis and recommendations will allow us to modify our maintenance practices and apply corrective treatment as necessary. The survey will also provide "leverage" as we seek funding for future conservation activities.

The survey will provide some of the documentation necessary for the Arboretum to apply for inclusion of the oak collection in the North American Plant Collections Consortium. Admission to the Consortium is selective and participants must meet strict standards for collections management. Inclusion of the oak collection in NAPCC will benefit researchers worldwide.

The long-term benefits of the proposed project will be improved health and longevity of the Arboretum's oak collection, which will benefit researchers, educators, students, and visitors who use the collection for study, recreation, or pleasure. The project has the potential to contribute to the preservation of oak biodiversity in the wild, since the collection represents a repository of documented genetic material that can be used for research, teaching, or ecological restoration.

## **6. HOW WILL THE APPLICANT ENSURE THAT ONGOING MUSEUM FUNCTIONS ARE NOT INHIBITED BY THESE PROJECT ACTIVITIES?**

Most of the project activities are minimally invasive and the small project staff will be unobtrusive at work. Visitor access to the oak collection will be only slightly limited during the data collection phase of the project. Most of the oaks in the collection are grouped in a large grove at the far western end of the Arboretum. The lawn areas in the grove will remain accessible, as will the main path through the grove. Some of the smaller side paths may be closed for short periods of time. Normal curatorial and horticultural activities will continue during the project. Access to researchers will not be limited. Educational signage will interpret project activities and explain the necessity of keeping the sampling pits, for example, off limits to visitors.

## **7. HOW DOES THE PROJECT BUDGET SUPPORT THE PROJECT GOALS AND OBJECTIVES?**

The project budget was developed by determining the activities necessary for an assessment of the oak collection and identifying the labor, supplies, equipment, and services necessary to carry



out each activity. Labor costs were determined by estimating the amount of time needed for each activity, assigning specific staff, consultant, or volunteers to each task, and applying the hourly rates of the person(s) assigned. Many of the activities were performed in 2001 in the Arboretum's redwood grove, by the same consultant, so we were able to extrapolate time and costs for this much larger project. Material and equipment costs were determined by actual quotes from suppliers or records of recent purchases.

We believe that the estimated project costs are reasonable and appropriate to the scope of the project. The oak collection includes a large number of specimens, and most of them are mature trees of large size. The oak grove where the environmental assessment will be conducted covers 7.5 acres.

We have used volunteers, student workers, groundskeepers, and entry-level professional staff whenever possible to keep costs down. The consultant's hourly rate of \$140 includes the principal of the firm and a skilled assistant, in effect doubling the work hours received. Because the consulting firm is located in our area, there are no travel or subsistence costs. We have scheduled excavation and other heavy work to reduce equipment rental expenses.

## **8. WHAT ARE THE QUALIFICATIONS AND RESPONSIBILITIES OF THE PROJECT PERSONNEL?**

Ellen Zagory, Collection Development Manager, will have overall responsibility for the project. She will meet regularly with project staff to plan and monitor project activities, oversee expenditures, and manage workflow. She will direct the water audit component of the project and analyze the water audit data. Ellen has been with the Arboretum since 1987 and holds a Master of Science degree in Environmental Horticulture from UC Davis, one of the top plant science schools in the world. Her horticultural expertise, her familiarity with the collection, her experience with similar collection evaluation projects elsewhere in the Arboretum, and her role as supervisor of horticultural staff make her participation essential to this project.

Emily Griswold, Horticultural Curator, will be responsible for the day-to-day work of the project. She will work with the consultant and serve as liaison to the campus Grounds Division and Facilities Services. She will collect all the background data needed for the project and assist with the water audit and other project activities. Emily holds a Master of Science in Urban Horticulture from the University of Washington, Seattle. She prepared the original curatorial assessment of the oak grove on which this project is based, working closely with Dr. John Tucker, professor emeritus of Botany, former director of the Arboretum, and a world-renowned expert on oak taxonomy. Her familiarity with the collection, with the Arboretum's plant records system, and with curatorial standards and practices make her participation essential to this project.

John M. Lichter of Tree Associates will be the consulting arborist for the project. He will conduct the horticultural evaluation of individual oak specimens and direct the environmental assessment, supervising the work of students, volunteers, and groundskeepers in environmental monitoring and data collection. Mr. Lichter holds a Master of Science degree in Environmental Horticulture from UC Davis, and is well respected in his field as an expert on tree health, safety, and conservation through corrective treatment. Mr. Lichter is an active member of the American Society of Consulting Arborists and the International Society of Arboriculture, an instructor and research associate for the UC Davis Department of Environmental Horticulture, and an instructor and research horticulturist for the US Forest Service Center for Urban Forestry. His many years' experience with a wide variety of tree species and their growth responses under a variety of environmental conditions provide him with the necessary background for evaluating and making recommendations for conservation practices needed to provide long term, quality care for the oak collection.

### Schedule of Completion

[illegible]

# **Denver Botanic Garden**

Denver, Colorado

Project Type: Environmental Survey

IMLS Award: \$42,069

Match: \$66,360

Total Project: \$106,829

Museum Budget: \$10,955,183

# IMLS 2003 Conservation Project, Environmental Assessment Grant Application

## Narrative

1. What is the design of the project? The accurate inventory and management of data is a basic principle for the development and utilization of collections. Since 1990, Denver Botanic Gardens (DBG) has used BG-BASE™ to document the living collections and their botanical nomenclature. DBG's data entry practices have proven reliable over time, but the general quality of data suffers from sporadic inventorying of plant collections, insufficient expertise in the identification of hybrids and cultivars, and inconsistent standards for communication between curators and the plant records department. In 2001, DBG conducted a general conservation survey with funding from the Institute of Museum and Library Services (IMLS) and completed by Dr. Dieter Wilkin, Mr. Charles Hubbuch, and Dr. Ronald Hartman (Supporting Document #3, Conservation Assessment of the Living and Non-Living Collections). The assessment specified the need for DBG to improve plant data gathering, data entry, and data interpretation, and is the basis for DBG's Long-Range Conservation Plan 2002 and Beyond (Supporting Document #4). DBG's recent purchase of BG-Map, the link between BG-BASE™, plant records, and an AutoCAD® design and mapping system, provides the Gardens with a tool to document and communicate the location of each plant in the collections.

The Long-Range Conservation Plan identifies and prioritizes DBG's collections conservation goals and objectives through year 2007. DBG's staff, executives, and board of directors are now focused on the first priority: to compile a thorough and ongoing assessment of DBG's plant collections. The collections categories include: Living Plants (six collections), Non-living Plants (two collections), and Support Collections (three collections). The initial priority will be to assess the living plants, which include the collections of alpine, aquatic, emergent, and carnivorous, herbaceous, native, tropical and subtropical, and woody plants.

DBG will initiate an environmental survey of all living plant collections at the York Street location, which includes forty outdoor gardens, the Tropical Conservatory, and supporting greenhouses. This assessment will begin in June 2003 and will be completed in Spring 2005. A complete garden-by-garden assessment will include site surveys, inventory updates, mapping, and representative photographic reproduction of all living plants at York Street. The information gathered will be translated and stored in the BG-BASE™ and recently acquired BG-Map databases, to be used to meet the Long-Range Conservation Plan's second priority: to appropriately communicate DBG's plant collections. The related objectives are as follows:

- a. Complete a written inventory of all living collections.
- b. Complete data entry into BG-BASE™ for all relevant inventory.
- c. Complete GPS surveying of all living collections.
- d. Complete the GIS BG-Map data entry of all living collections.
- e. Develop a representative photographic record of all significant living collections.
- f. Link digital images and all other metadata to BG-BASE™.
- g. Create links to [www.botanicgardens.org](http://www.botanicgardens.org) and other medium.

To accomplish these objectives, DBG will employ two teams composed of DBG staff, interns, and contracted consultants. The first team is the Survey, Inventory, Map, and Photograph team (SIMP team). This team will conduct a garden-by-garden assessment, recording each plant's GIS coordinates, description, and digitally photographing representative species of each identified plant. The SIMP team is comprised of DBG's taxonomic database manager, (the project leader), a contracted botanist, two interns, and curatorial staff and other contracted or volunteer collections experts as assigned.

The SIMP team will begin the assessment in early summer, when plants are easily identified. As much outdoor work as possible will be completed before the first seasonal frost, generally occurring in mid-September. The data gathered will be documented on the DBG Plant Inventory and Mapping Form (Supporting Document #6), or directly entered into an on-site laptop computer for later download into BG-BASE™ and/or BG-Map. This plan

allows the SIMP team to complete multiple tasks one garden at a time. In this way, the garden is not disturbed by multiple assessment processes at different times, and the public can enjoy all other displays during the assessment process.

The second project team is the Data entry team (D-team) comprised of DBG's research manager, taxonomic database manager, plant recorder, two interns, and contracted database developer. The D-team will enter information related to the culture and history of the plant species as well as general techniques for cultivation. The metadata entered into BG-BASE™ will be linkable to BG-Map, with digitized images stored for future educational and interpretive medium.

The SIMP team will begin operations in June 2003, continuing in June 2004. Operating concurrently and through the fall and winter months, the D-team will assist the SIMP team in downloading all inventory, plant location information, and digital records into the BG-BASE™ and BG-Map databases. In winter 2004, the project leader, curator of tropical and subtropical collections, and a contracted tropical and subtropical collections expert will validate and update the current assessment of the indoor Tropical Conservatory and supporting greenhouses. This expert is necessary as the Gardens houses many unique specimens not commonly found. The contracted expert will also assist interpretation of the tropical and subtropical collections, as public interpretation of these collections is a priority for the Gardens. Fall and winter 2004 and 2005 will see the completion of data entry and metadata links, with digitized images also entered into BG-BASE™. The project manager will also work with DBG's operations/irrigation specialist throughout the course of the project to correctly map electrical and irrigation systems located throughout the Gardens.

By completing this process, DBG will vastly improve information sharing with a systematic approach to managing and providing access to collections for both professionals and the public. DBG will use this information as the basis of a comprehensive interpretation of its collections in 2004 and 2005, which may include brochures, plant labels, interpretive signage, kiosk information about specific collections, hand-held technology for plant information, on-line maps, and assessment information available to the public through DBG's website [www.botanicgardens.org](http://www.botanicgardens.org). Digitization of current representative plant species will allow DBG to provide useful photographic information about these plants even when the plant is no longer available in that garden.

**2.a. What are the proposed conservation methods and why are they conservationally sound?** The identification, inventory, mapping, and photographic documentation of collections is the basis for conserving living plant collections of value, and provides the information necessary to interpret collections to the public. DBG's proposed conservation methods are essential to updating and improving the accuracy of DBG's records, while improving the system of recording keeping within the organization and information sharing between departments. BG-BASE™ information management and data retrieval have proven reliable over time. Recent breakdowns in record keeping and plant labeling are due to inadequate communication between DBG's horticulture and plant records departments. To address this problem and prepare for an extensive assessment of DBG's living collections, a number of means for communication have been instituted. These include: weekly meetings attended by the curators, horticulturists, and plant records staff; altering the job descriptions of horticulturists to specify various plant records duties; and plant records staff assisting horticulturists with basic garden record maintenance and inventory. Team members must perform these duties to provide the framework for implementing the Living Plant Collections assessment planned activities. The concepts of systematic record keeping based on annual inventory and digital mapping of collections are not new, but the methods are constantly improving and becoming more useful for the institution and general public. DBG's plans to inventory, map, photograph, and maintain plant records are based on the practices of leading botanic gardens such as Cornell Plantations, New York Botanical Garden and Royal Botanic Gardens, Edinburgh, and are accepted as standard approaches to modern conservation of valued collections. The collections will remain alive and undisturbed since the practices implemented during the assessment will not involve any destructive sampling, manipulation of collections, or changes in the plant's current habitat.

### **3. What is/are the object(s), historic structure(s), or specimen(s) that is/are the focus of this project?**

In pursuit of its mission to connect people with plants, DBG houses living, non-living, and support collections. DBG's collections are categorized as follows:

#### **Living Plant Collections**

1. Alpine Plants
2. Aquatic, Emergent, and Carnivorous Plants
3. Herbaceous Plants (annuals and perennials)
4. Native Plants
5. Tropical and Subtropical Plants
6. Woody Plants

#### **Non-living Plant Collections**

1. Mycological Plants
2. Vascular Plants

#### **Support Collections**

1. Books and Printed Materials
2. Historic Structures
3. Photos and 35mm Slides

DBG's assessment will begin with the living collections, as they represent six of the total eleven collections. At this time, approximately fifty-five percent of the living collections are accessioned with several gardens and collections having ninety-nine percent inventory accuracy. In outdoor living collections at York Street (9,728 taxa), DBG holds a significant number of native plants from the Rocky Mountain and Plains regions (684 taxa), some of which are rare and/or endangered. Rare and endangered species such as *Physaria bellii* and *Eustoma grandiflorum* are used in displays, research, and in situ conservation work. Its alpine collection is one of the most geographically diverse and comprehensive in the country (4,977 taxa). Highlights of this collection include many species of *Penstemon*, *Draba*, *Acantholimon*, and *Phlox*. The North American Rock Garden Society and DBG support national and international plant expeditions, which have assisted in the development of this collection. Situated in a steppe climate at the foot of the Rocky Mountains, DBG holds significant collections from similar climatic regions around the world including Patagonia, North Africa, and Central Asia. Aquatic collections, with thirty-six species and over 214 cultivars, are nationally renown for their diversity and beauty. These collections include *Nymphaea*, *Victoria*, and *Nelumbo* species. Conservatory collections represent tropical biomes throughout the world including Africa, Australia, Madagascar, South America, and New Guinea (6,493 taxa). Aquatic pools in the Tropical Conservatory hold an important collection of wild collected species of *Nymphaea*. DBG excels in collections of epiphytic plants from families including Orchidaceae (1,926 taxa), Bromeliaceae (1,500 taxa), and Araceae (282 taxa). Over the last twenty years, the bromeliad collection has been developed into one of the largest and most diverse in the county with particular strength in *Tillandsia* and the xeric genus *Hechtia*.

The herbaceous collections of DBG are represented throughout the gardens: from the entrance Mile High Garden's showcase of plants that perform well in the Front Range area to the Romantic Garden's vast collection of herbs, perennials, and bulbs. The plants within the herbaceous collection are shown in multiple variations and styles, from the formal Herb Garden to the impressionistic Monet Garden, so that visitors may learn how the plants function in different applications and different combinations. Also included in the herbaceous collection are container plants, including tropical plants, carnivorous plants, cacti and succulents, ornamental grasses, and annuals. DBG presents multiple cultivars to show the variation within different species as well as plants that do well in the Front Range and are commercially available.

Woody plant collections within DBG include plants within the Aceraceae, Caprifoliaceae, Cupressaceae, Fagaceae, Pinaceae, and Rosaceae families among many others. These include both cultivated and individual

plants collected from the wild, either as seed or specimen. Many of the plants within the woody collections are unusual plants within the Denver area, showing the diversity of hardy species beyond the native pines and aspens. The plants of Asia are represented in collections found in PlantAsia and the Japanese Garden, while natives of South Africa are located in the South African Plaza.

**4. How does the project relate to your museum's ongoing conservation activities?** DBG's planned environmental assessment will have significant impact on the daily and long-range conservation of the plant collections. DBG's plant collections are the anchor of the institution, and it is imperative that these collections be properly identified and labeled, with accurate data on each plant stored in a centralized database. Completion of the proposed environmental assessment will provide better information to staff concerning the location, condition, and past management of specimens and collections. With improved knowledge and access to these records, DBG provides information for better maintenance and interpretation of the collections.

In 2001, DBG participated in a General Conservation Assessment Survey after receiving an IMLS Conservation Project Support grant. A team led by Dr. Dieter Wilkin, Vice President for Programs and Collections at the Santa Barbara Botanic Garden, reviewed DBG's outdoor, indoor, and herbarium collections. This survey was the basis for initial curator and horticulture staff meetings to specifically identify DBG's short- term and long-term collections conservation issues. Identified issues became the focus for DBG's conservation planning committee, comprised of the director of horticulture and operations, curator of living plant collections, DBG curators, and select horticultural staff. The outcome of these meeting is the documented Long-Range Conservation Plan, 2002 and Beyond.

The Long-Range Conservation Plan was approved October 2002 for implementation garden-wide. This plan provides vision and direction by addressing identified collections needs through 2007, and directly supports DBG's proposed environmental survey project. This project provides a standardized framework to improve recordkeeping and labeling, while adding a geo-spatial element to DBG's management of the collections. Additionally, DBG can collect the data necessary to interpret the collections to the public in interesting and unique ways.

DBG has made significant financial commitment to the care of its collections. The Gardens currently employs five full-time living plant curators, two part-time non-living plant curators, and two plant records staff. Additionally, a twenty-two person horticulture department cares for the collections on a daily basis. DBG is also seeking funding for structural improvements to properly maintain its Living, Non-Living, and Support Collections.

**5. What are the anticipated benefits of this project?** The mission of DBG is to connect people with plants. Botanic gardens can achieve this goal through various scientific, educational, and aesthetic programs, but museums must also be devoted to the procurement, care, study, and display of collections. DBG's goals and collections are intricately related to each of these categories, both botanic garden and museum. The proposed assessment gives DBG the opportunity to update plant records, while preparing the framework to facilitate innovative means of managing and interpreting collections. The SIMP and D-teams will develop a complete, accurate record of DBG's plant collections, and provide correct, up-to-date inventories that facilitate plant labels and other interpretation. This is especially important for theme gardens that communicate pertinent environmental or cultural messages (Endangered Species Garden, Sacred Earth Garden, Roads Water Wise Garden, Laura Smith Porter Plains Garden). DBG's curators will have improved access to information about plants in their collection, specifically plant locations and conditions. This information will assist in the maintenance and development of collections and determining appropriate goals, focus, and interpretation of the collections. In addition to the aesthetic beauty of a garden, accurate information must be made available to the public, primarily via plant labels, interpretative signage, and digital alternatives. The assessment will provide the information to internally track collections and the historical management practices, while supplying information for public use and a digital framework or creative methods of information dissemination. Currently, basic plant collections data is available

online. This project will combine the information and technology necessary to provide online, dynamic maps of plant locations and specific information about the plants, including cultural information and photographs. This information will be included in digital kiosks and other interpretive materials, and access via [www.botanicgardnes.org](http://www.botanicgardnes.org) to a plethora of plant and historical information, maps, and photographs.

**6. How will the applicant ensure that ongoing museum functions are not inhibited by these project activities?** In 2002, DBG hired a taxonomic database manager to implement the first priority of the *Long-Range Conservation Plan, 2002 and Beyond*. This goal, to compile a thorough and ongoing assessment of DBG's collections, begins with DBG's Living Plant Collections. The taxonomic database manager has been involved in all planning, and was instrumental in the development of the SIMP and D-team concepts. Her projected deadline for completion is spring 2005. DBG's plan for a coordinated and intensive team assessment, coupled with the use of talented specialists, will ensure that this project is completed efficiently and correctly. The SIMP team will complete a thorough assessment of one garden before moving to the next. During this period, all of DBG's forty gardens will remain open. DBG anticipates a high level of public interest in the surveying, inventory, and mapping of the Gardens, and the current timetable for completion is designed to provide time for team discourse with visitors about what is being accomplished. A number of volunteers have also expressed interest in being part of the SIMP and D-teams, which will provide them with a hands-on educational experience. Indoor gardens will also remain open during the assessment process. DBG has committed significant funds through the purchase of BG-Map, digital cameras, GIS equipment, and development of a template for the computer entry of digitized images. Significant DBG staff time will be committed to both the SIMP and D-teams in an effort to expedite the project.

**7. How does the project budget support the goals and objectives?** The environmental assessment project was developed by a committee of DBG employees, including the director of horticulture and operations, curator of living plants, plant curators, research manager, and taxonomic database manager. This team had originally been assigned to complete DBG's *Long-Range Conservation Plan, 2002 and Beyond*, and development of the assessment project was an extension of the team's desire to address the first priority of the plan. Project costs were determined by contacting other botanic gardens to determine current costs for contracted botanists and curatorial specialists, as well as contacting known contractors directly. DBG staff and intern salaries are based on DBG's current pay structure and benefits packages for these positions. Costs for equipment and supplies are based on estimates obtained in summer 2002.

**8. What are the qualifications and responsibilities of the project personnel?**

- Taxonomic database manager (project leader) job summary: The project leader schedules, organizes, and oversees activities of the SIMP and D-teams to meet goals and objectives of the project. Oversees budget, responsible to assist grant writer in completing funding agency's required reports. Qualifications and experience as required by Denver Botanic Gardens (attachment)
- Botanist job summary: Acting under the direction of the project leader, the botanist assists with the identification of plants, mapping, and data entry of living plants at Denver Botanic Gardens and provides day- to-day leadership and direction for the SIMP team. Qualifications: Current graduate student or recent graduate in the field of botany, plant taxonomy, or horticulture. Experience: Experience in plant identification, database entry, and GIS or BG-Map software desirable. Excellent interpersonal and leadership skills are required.
- SIMP team interns job summary: Acting under the direction of the project leader and under direct supervision of the botanist, assists with the mapping and data entry of living plants and infrastructure of each outdoor garden at DBG, York Street. Qualifications: Current undergraduate or graduate student in the field of botany, plant taxonomy, or horticulture. Experience: Understanding of botanical nomenclature and database entry required, with an understanding GIS or BG-Map software preferred.



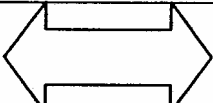
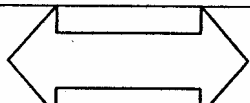
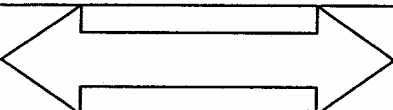
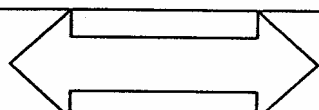


- **D-team interns job summary:** Acting under the direction of the project leader, assists with research and addition to the database (BG-BASE™) of correct descriptive information for plants. Qualifications: Current undergraduate student or recent graduate in the field of horticulture, botany, or related field. Undergraduate class work in horticulture or botany or work experience in the areas of horticulture or natural resource management. Experience: Basic knowledge of botanical nomenclature and database entry required. Familiarity with BG-BASE software and experience in library and Internet research preferred.
- **Curator job summary:** Acting under the direction of the project leader, assists the assessment process by locating and identifying specific taxa of their collections. Other duties as assigned. Qualifications and experience as defined by Denver Botanic Gardens (attachment).
- **Contracted plant specialist job summary:** Acting under the direction of the project leader, provides proper identification and horticultural information for plants in collections area of expertise. Qualifications: Knowledge of specialized living plants collections. References and/or list of recent publications in their field of expertise required. Experience: Ten years experience in the specified collections area.
- **Contracted tropical and subtropical plant specialist job summary:** Acting under the direction of the Project Leader, provides proper identification and horticultural information for plants in the Tropical Conservatory and supporting greenhouses at DBG. Qualifications: Knowledge of tropical flora including palms, bromeliads, and orchids. References and/or list of recent publications in area of tropical and subtropical plants required. Experience: Ten years experience in tropical and subtropical flora identification and management.
- **Research manager job summary:** Provide guidance and assistance with information enrichment and database development, digitization, image processing, GPS and GIS use. Qualifications and experience as required by Denver Botanic Gardens (attachment).
- **Plant recorder job summary:** Acting under the direction of the project leader, provides oversight to interns and assistance in downloading all inventory, plant location information, and digital records into the BG-BASE™ database. Qualifications and experience as required by Denver Botanic Gardens (attachment).
- **Operations/irrigation specialist job summary:** Acting under the direction of the project leader, assists in correctly identifying and mapping electrical and irrigation systems of Denver Botanic Gardens. Qualifications and experience as required by Denver Botanic Gardens (attachment).
- **Contracted database developer job summary:** Acting under the direction of the project manager and research manager, provides expertise in best methods of data linkage, management of information, technology, and advances. Provides programming language (PERL scripts and CGI code) and other technical expertise as needed to connect database information with Internet. *Qualifications:*  
*Experience:*

Given the high priority of this project, DBG's project leader will be required to spend approximately one-third of her time overseeing the assessment. The contracted botanist will provide day-to-day oversight of the SIMP team's activities, and will therefore be contracted for two growing seasons (approximately three months, June, July, and August) over two years. Each summer, two interns will assist in on-site data collection and data entry. Each fall and winter, two interns will assist the plant recorder in data entry for a total of 520 hours each. DBG's operations/irrigation specialist will provide seventy-five hours of expertise assisting in the development of the irrigation, lighting, and hardscape layer of the site map. Curators will be assigned to the SIMP team as needed to assist plant identification. No curator will be assigned to the assessment for more than one hundred hours, with the exception of the curator of living plants. This curator will be required to spend 150 hours in the assessment process, as he has both insight into the major collections of alpine plant, woody plant, and herbaceous plant collections, and over twenty years experience as a DBG employee. Experts in living plant collections will be contracted only when all other resources for plant identification have been exhausted, with the majority of budgeted contractual funds committed to a specialist in tropical and subtropical plants to properly identify and assist in conservation of this important collection.

### Schedule of Completion

**Explanation:**

2003								2004								2005							
May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April

SIMP's Team		
D - Team		
Tropical/Subtropical Collection's Expert		
Operations/Irrigation Specialist		
Database Developer		

# **North Carolina Aquarium/Roanoke Island**

Manteo, North Carolina

Project Type: Research

IMLS Award: \$49,900

Match: \$68,805

Total Project: \$118,705

Museum Budget: \$88,000

## 1. What is the design of the project?

The American Zoo and Aquarium Association (AZA) Sea Turtle Working Group is currently developing husbandry, medical care and rehabilitation guidelines for sea turtles. Rehabilitating sick and injured sea turtles is a common conservation program at many zoo and aquarium facilities, yet few guidelines exist, and no in-depth studies have been done on post-release survival and behavior. The North Carolina Aquarium on Roanoke Island (NCNRI) is requesting funds (\$49,800) to study the efficacy of human intervention on sea turtle survival. The goals of on-going conservation programs at the NC Aquariums (NCA) are to rehabilitate and release sea turtles that are stranded along our coast. Typically the NCA receive cold-stunned juvenile sea turtles in late fall, when animals should be migrating to warmer waters. Sea turtles that are exposed to cold-water temperatures will become lethargic, and body functions cease. With proper care the NCA have rehabilitated and released 93.5% of live stranded turtles brought to rehabilitation from 1997 -2001 (43 total). Rehabilitation efforts require a significant amount of time and resources, and we currently operate under the assumption that the turtles survive and behave normally once released. We believe long-term monitoring of released animals is necessary to determine the efficacy of our sea turtle rehabilitation program, which is our highest collections care priority.

The technology to remotely monitor animals at large in the field is now developed. Satellite telemetry has been used successfully to monitor the movements of sea turtles, and has been particularly useful in studying the migration and foraging behavior of marine turtles over large distances and over long periods of time (1, 2, 3, 4, 5). Natural dive patterns of sea turtles have also been studied using satellite telemetry (6, 7, 8). Several studies tracked captive-reared turtles (9, 10). There is also only limited published information on health assessment and clinical pathology values of rehabilitating sea turtles (11).

### Purpose:

The purpose of the project is to use satellite telemetry to track cold-stunned rehabilitated loggerhead sea turtles (*Caretta caretta*) rescued along the North Carolina coast that are held at the North Carolina Aquariums, and released back to coastal waters.

### Objectives:

1. To collect data on clinical pathology values of rehabilitated loggerhead sea turtles.
2. To assess survival of rehabilitated and released loggerhead sea turtles.
3. To compare migration patterns and dive behavior (duration and maximum depth) of rehabilitated loggerhead sea turtles to previously published data for wild turtles.
4. To evaluate the effectiveness of conservation programs for stranded sea turtles at the North Carolina Aquariums (NCA).
5. To develop an educational website and exhibits at the NCA using the data and information generated during the tracking project (additional funds requested in education component).

### Project activities

Live-stranded juvenile loggerhead sea turtles will be brought to the North Carolina Aquariums on Roanoke Island (NCNRI) and Pine Knoll Shores (NCNPKS) for rehabilitation during the fall/winter of 2003/2004 and 2004/2005 by volunteers for the North Carolina Wildlife Resources Commission (NCWRC) and the NCA. A total of twelve rehabilitated juvenile loggerhead sea turtles « 87.0 cm curved carapace length}, each weighing approximately 50 pounds, will be selected for the study by Veterinarians from the North Carolina State College of Veterinary Medicine (NCSU/CVM) based upon criteria established by the NCSU/CVM in cooperation with the NCWRC (Appendix 1). Only juvenile sea turtles will be selected for the study because age (based on size) will have the strongest influence on post-release movements (see sections 2a, 3). During the period of captivity and before release, blood will be drawn from each turtle for routine complete blood counts (CBC), serum biochemical analysis, and sex determination. Sex will be determined by testosterone radioimmunoassay (12). Given that a majority of turtles from all sites

in the southeastern US have the same haplotypes, natal region is not expected to influence post-release movements of juvenile loggerhead sea turtles (13).

Telonics ST-14 PTT satellite transmitters (Appendix 2.) will be securely fastened onto the carapace of each turtle before they are released. The transmitters will be programmed to collect data on the turtles' location (latitude and longitude), water temperature and dive profiles (duration and maximum depth). In order to lengthen battery life, these transmitters will be duty cycled on and off, and programmed with a salt-water switch to stop transmission when the turtle is submerged. The uplink is initiated by an air break at the surface. Operational life is estimated to be 6-10 months based on a 25% duty cycle for juvenile loggerheads which are below the water surface > 50% of the time (Appendix 2.)

In addition to a transmitter, inconel tags will be attached to the rear flippers and passive integrated transponders (PIT) tags inserted in the front flippers of each turtle as part of a collaborative tagging program with the National Marine Fisheries Service (NMFS). Study turtles will be injected with oxytetracycline (25 mg/kg IM) as a biomarker for the NMFS skeletochronology lab. Inconel and PIT tags allow longer-term mark and recapture studies; oxytetracycline injections provide a biomarker to assess growth and age (14). Project consultant Dr. Matthew Godfrey, NCWRC, will issue the necessary permits for the project.

#### Data collection and analysis

A total of twelve hypothermic-stunned, rehabilitated loggerhead turtles will be tagged and released in summer 2003 and 2004. The turtles will be released in coastal waters selected by the NCWRC Sea Turtle Program Coordinator. Each time a turtle surfaces to breathe, data will be transmitted to polar orbiting satellites in the Argos system, and then automatically sent to a receiving station on the ground. Location data are calculated using Doppler shift, and transmitters will be equipped with sensors for recording data on water temperature and dive profiles (duration and maximum depth). The Global Processing Center (GPC) operated by Service Argos, Inc. (SAI) in Largo, Maryland will check the data for accuracy, then process, distribute and archive the data so they are available to registered users online.

Information collected by health assessment and clinical pathology values will be used to establish additional guidelines for rehabilitation and release. The length of each track will be determined by the life of the transmitter battery, generally 6-10 months based on previous studies. Eventually the adhesive used to secure the transmitter will weaken, and it will detach. In the event that a tagged turtle subsequently strands dead, a necropsy with histopathology will be completed.

Tracking twelve rehabilitated turtles over a two-year period allows for a reasonable sample size for comparison between rehabilitated turtles and published data for wild turtles. We will also be able to analyze the contribution of factors such as sex and length of time in rehabilitation in the observed results. Data on mean dive duration that meet parametric statistical assumptions will be compared utilizing analysis of variance. Water temperature, maximum depth and location data will be analyzed using Kruskal-Wallis nonparametric analysis of variance. Multiple range comparisons will be used to analyze significant differences between rehabilitated and wild turtles.

#### Personnel

The North Carolina Aquarium Society will serve as the fiscal agent for the project. Joanne Harcke, NCA/RI Conservation and Research Coordinator, will be the Principal Investigator. Ms. Harcke will coordinate the project, facilitate the tagging and release of turtles, manage the data from SAI, oversee web site development/management, assist with data analysis and publications, and coordinate dissemination of results for public exhibits and educational programs (20% effort). Dr. Craig Harms from the NCSU/CVM will select animals to be included in the study, provide medical care, determine when each turtle is releasable, attach transmitters, and assist with data analysis and publications (26 days total). Dr. Matthew Godfrey, NCWRC Sea Turtle Program Coordinator, will tag and attach transmitters to each turtle, coordinate the releases, assist with data analysis and publications (13 days total).

### Schedule and Dissemination of Information

Husbandry staff and volunteers from the NCA and NCWRC will feed and care for turtles in the rehabilitation facilities, under the supervision of the Conservation and Research Coordinator. Rehabilitated turtles will be tagged and released in summer 2003 and 2004, which will allow 6-10 months to track before the project completion date April 30, 2005.

Because additional information on clinical pathology values, medical care and rehabilitation guidelines for sea turtles are needed, our goal is to produce at least three peer-reviewed publications during this project. The first publication will be the preliminary results for sea turtles tagged and released during 2003. Final results will be reported in a second paper, published at the study's end. Clinical pathology values for rehabilitated sea turtles will be combined with additional data collected by the NCSU/CVM to produce a more comprehensive third paper. This information will be valuable for other sea turtle rehabilitation facilities worldwide, and will be used to establish standardized guidelines for rehabilitation and release in NC. Data will be presented at the Annual Symposium on Sea Turtle Biology and Conservation, and potentially at other meetings.

Maps of sea turtle movements will be created using the location data. A web page will be developed by a paid consultant (webslingerZ Inc.) that will include a narrative description of the project, a section for updated information and maps, similar to pages created by the NC Zoological Park, Caribbean Conservation Corporation, and the Virginia Institute of Marine Science (funds requested in education component). Additionally the data will be presented at existing live sea turtle exhibits and during public educational programs at all three NCA.

### **2a. What are the proposed conservation methods and why are they conservationally sound?**

All sea turtle species are listed as threatened or endangered, and are protected by law. Rehabilitation of stranded turtles is one focus of the AZA Sea Turtle Working Group. Sea turtles presented to rehabilitation facilities are commonly suffering from traumatic injury, entanglement in fishing line or nets, gastrointestinal obstruction, buoyancy disorders, emaciation, and hypothermia (15). It has been shown by previous studies that juvenile loggerheads migrate south from the Chesapeake Bay in the fall, staying relatively close to the coast (16, 17, 18). Typically juveniles leave the NC sounds in December and travel south around Cape Hatteras (19). By January, most are south of Cape Hatteras, with few remaining off the Coast of NC at the edge of the Gulf Stream (20). It is hypothesized that cold-stunned animals do not leave the sounds and reach warmer waters before the first significant cold weather causes inshore water temperatures to plummet. Given proper veterinary and husbandry care, most live-stranded cold-stunned sea turtles can survive to be released. Population growth rates for loggerhead sea turtles are linked to survival at the juvenile stage (21), therefore conservation efforts in NC must include reduction of threats to this critical stage. Based on the mean carapace length, a majority of live-stranded loggerhead sea turtles in NC to date have been juveniles with an average carapace length 68.5 cm (range 52.4-77.3). These juveniles tend to live-strand at approximately the same time, and are held in rehabilitation until water temperatures warm in the early summer. The average length of stay is 149 days (range 129-161).

Conservation efforts should be based on our best estimate of the population's response to varying management alternatives. Therefore, we must strive to determine the post-release survival of rehabilitated sea turtles in order to assess the efficacy of our rehabilitation programs.

Satellite telemetry provides a cost effective and efficient means of monitoring sea turtle migration and behavioral parameters in the field (22). Transmitters are now smaller, better hydro-dynamically designed, and more reliable. Additionally, methods for transmitter attachment have been refined and published (23, 24, 25). Satellite telemetry has been used successfully by many researchers and is a safe, effective method to study sea turtles in the field.

### **3. What is the object(s), historic structure(s), or specimen(s) that is the focus of this project?**

The Endangered Species Act (ESA) currently lists loggerhead sea turtles (*Caretta caretta*) as a threatened species. It is estimated that only 0.01 to 0.1% of sea turtle hatchlings survive to reproduce (26). Threats to survival exist at all life stages, and include loss of nesting beaches and foraging grounds, predation, interactions with fishing gear, ingestion of marine debris, and pollutants. However, reductions in juvenile and/or adult mortality may have the largest effect on increasing loggerhead population growth (27).

Protection measures for sea turtles include preservation of nesting beaches, development and use of turtle excluder devices (TEDs) on fishing nets of trawlers, public education programs, and the creation of rehabilitation facilities. In a national AZA survey conducted in 1996, 27 AZA facilities reported holding sea turtles, and many are also involved with rehabilitation efforts (28). Worldwide, 49 facilities (private and public) are listed as sea turtle rescue, treatment and rehabilitation organizations (29). The NC Aquariums at RI and PKS work with Veterinarians, the North Carolina Wildlife Resources Commission (NCWRC) and local volunteers, to rehabilitate injured and hypothermic-stunned sea turtles.

The mean carapace length for nesting female loggerheads is 87.0 cm (30). Between 2000-2002 the average carapace length of cold-stunned loggerhead turtles rehabilitated at the NCA was 68.5 cm (range 52.4-77.3 cm). At > 50 cm both male and female juveniles in the western Atlantic recruit from oceanic pelagic to neritic demersal habitats (31), and typically make definite seasonal foraging migrations, moving north as far as Long Island, NY in the summer months, and returning south in cooler weather. Juveniles show strong foraging site fidelity (32). All loggerhead sea turtles rehabilitated at the NCA were juveniles, subadults and young adults that are considered to be the most critical in terms of affecting population growth rates (33,34). If rehabilitation efforts are successful, the increased survival of juvenile loggerheads should result in a larger number of turtles reaching maturity.

Each of the NCA maintains live sea turtles on exhibit. Most display turtles are nonviable hatchlings removed from nests during excavations that most likely would not have survived in the wild. These animals are a unique resource and help meet the aquariums' mission to promote an awareness, understanding, appreciation and conservation of the diverse natural and cultural resources associated with NC's ocean, estuaries, rivers, streams, and other aquatic environments.

### **4. How does the project relate to your museum's ongoing conservation activities?**

Conservation efforts at the NC Aquariums focus on rehabilitating sick and injured turtles that can be released back to the wild. Other conservation programs include rearing blue crabs for stock enhancement, mapping paddling trails, participating in Adopt-A-Highway and Big Sweep cleanups, and hosting annual Earth Day festivals. In 2000, the NCA/RI hired a full-time Conservation and Research Coordinator to expand existing programs and develop new areas of research. The Coordinator spends approximately 33% of her time on the sea turtle conservation program, and this program accounts for over 50% of the Conservation and Research budget. This year the Coordinator is also developing a sea turtle educational website with the NC Zoo and webslingerZ, Inc. as part of the Zoo's Field Trip Earth Program. Ms. Harcke is a member of the AZA Sea Turtle Working Group, and collaborates with the NCSU/CVM and the NCWRC Sea Turtle Program. The NCA are committed to working with the NCWRC and local volunteer groups to maintain and improve sea turtle rehabilitation programs, and to educate the public on sea turtle conservation issues.

Efforts to recover and study stranded marine turtles are recognized as major assets to onservation, as well as significant humanitarian acts (35). Sea turtles found on North Carolina beaches during the winter are often suffering from hypothermic-stunning. This condition occurs when turtles are exposed to cold water for a period of time, and the core body temperature drops below a critical level. Inshore populations are most susceptible because of the rapid temperature

change that can occur in shallow water, and smaller turtles cold stun sooner than larger animals (36). These turtles become very lethargic, surface and are found washed-up on beaches. With the assistance of volunteer groups, the NCA/RI and NCA/PKS rescue and rehabilitate numerous hypothermic-stunned sea turtles each year. Over the past five years, aquarium staff and veterinarians have developed diet and treatment protocols that have resulted in a high recovery rate for live-stranded sea turtles (Figure 1 ).

#### **5. What are the anticipated benefits of this project?**

By attaching satellite transmitters to sea turtles before release, we will conduct the first large scale tracking study of rehabilitated and released loggerhead sea turtles. The data collected by this project can be used to assess whether rehabilitated loggerhead sea turtles are likely to survive and behave normally after release. In addition, data collected on clinical pathology values will be beneficial to other facilities involved with treating and holding sea turtles.

Latitude, longitude and water temperature data will contribute to information on migration patterns of sea turtles along the NC coast. Dive duration and maximum depths recorded can be compared to published values for natural dive patterns (37), in order to compare the dive physiology of released turtles. Results will be published in peer-reviewed journals and presented at scientific meetings, as well as in public programs and exhibits at the NC Aquariums.

We will test the hypotheses that (a) released rehabilitated loggerheads survive in the wild as least until PTTs stop transmitting data, and (b) there will be little difference in dive profiles and migration patterns between the rehabilitated and previously tagged wild-caught turtles, after released animals become acclimated to their surroundings. Positively confirming these hypotheses would show that programs at the two North Carolina Aquariums to rehabilitate hypothermic-stunned sea turtles would be effective conservation strategies for these endangered and threatened species.

The North Carolina Aquariums are in a unique position to conduct research and disseminate results directly to the public. This conservation project offers an opportunity to blend innovative research, conservation efforts and education. Public access to this information through the Internet, educational programs, and exhibits will increase understanding, and encourage the protection of threatened and endangered sea turtles.

#### **6. How will the applicant ensure that ongoing museum functions are not inhibited by these project activities?**

Advantages to satellite telemetry include that once the transmitters are attached and the animals released, data are collected and downloaded automatically. Therefore, limited staff time will need to be allocated to the project after the initial tagging and release. Animals in captivity will continue to be cared for normally, with no disruption to the husbandry schedule. All rehabilitated turtles will be released when health criteria are met (Appendix 1) and ocean water temperature is greater than 70 F. Based on previous studies cited, transmitter attachment will not compromise the health and welfare of the animals after release.

The Conservation and Research Coordinator was hired by the aquariums specifically to facilitate programs outside of normal aquarium activities. In addition to this salaried position, the aquariums will continue to contribute funds for veterinary care, food, and other supplies for holding sea turtles in rehabilitation and on display. Volunteers will also contribute time to care for animals.

#### **7. How does the project budget support the project goals and objectives?**

This conservation project assessment requires personnel time (staff and consultants), supplies and travel costs. Personnel time includes the Principal Investigator, Veterinarian and NCWRC Sea Turtle Program Coordinator, to rehabilitate, tag and release turtles, analyze data, and prepare publications. Transmitters and satellite time comprise a majority of the supply budget, although veterinary care, medical supplies, food, salt, water and electricity will also be required.



Travel expenses are necessary for the project coordinator to oversee care at the rehabilitation facilities, and for project personnel to tag and release rehabilitated turtles.

A total of \$49,800 is requested (44% of total project costs) to purchase transmitters, satellite time, and for extra veterinary expenses related to the project (serum biochemical analysis and genetic testing to determine natal region). This technology is cost-effective, we believe the benefits to monitoring multiple sea turtles for long periods of time in the field outweigh any disadvantages. Aquarium matching funds include routine veterinary care, husbandry equipment, and in-kind contributions of staff time, husbandry supplies (food, salt, water, etc.), and travel expenses.

#### **8. What are the qualifications and responsibilities of the project personnel?**

Project personnel include Ms. Joanne E. Harcke, Dr. Craig A. Harms, and Dr. Matthew Godfrey. The Principal Investigator will be responsible for coordinating the project and disseminating results. The Project Investigators, who both have extensive experience with sea turtles, will jointly conduct project activities.

##### Joanne E. Harcke. M.S.. Conservation and Research Coordinator. North Carolina Aquarium on Roanoke Island. Principal Investigator

Joanne Harcke earned her M.S. degree in Zoology from North Carolina State University, and is the Conservation and Research Coordinator at the North Carolina Aquarium on Roanoke Island. She is responsible for the aquarium's Sea Turtle Rehabilitation Facility, and supervises the treatment and care of rehabilitating animals. Ms. Harcke oversees all research activities conducted at the aquarium. She is a member of the AZA Sea Turtle Working Group, and the NC Herpetological Society. As project coordinator, Ms. Harcke will oversee rehabilitation efforts at the two aquariums, facilitate the tagging and release of turtles, manage the data from SAI, oversee web site development and management, assist with data analysis and publications, and coordinate the dissemination of results for public exhibits and educational programs. (20% effort each project year.)

##### Craig A. Harms. DVM. Ph.D.. Diplomate ACZM. Research Assistant Professor. North Carolina State University/College of Veterinary Medicine. Project Investigator

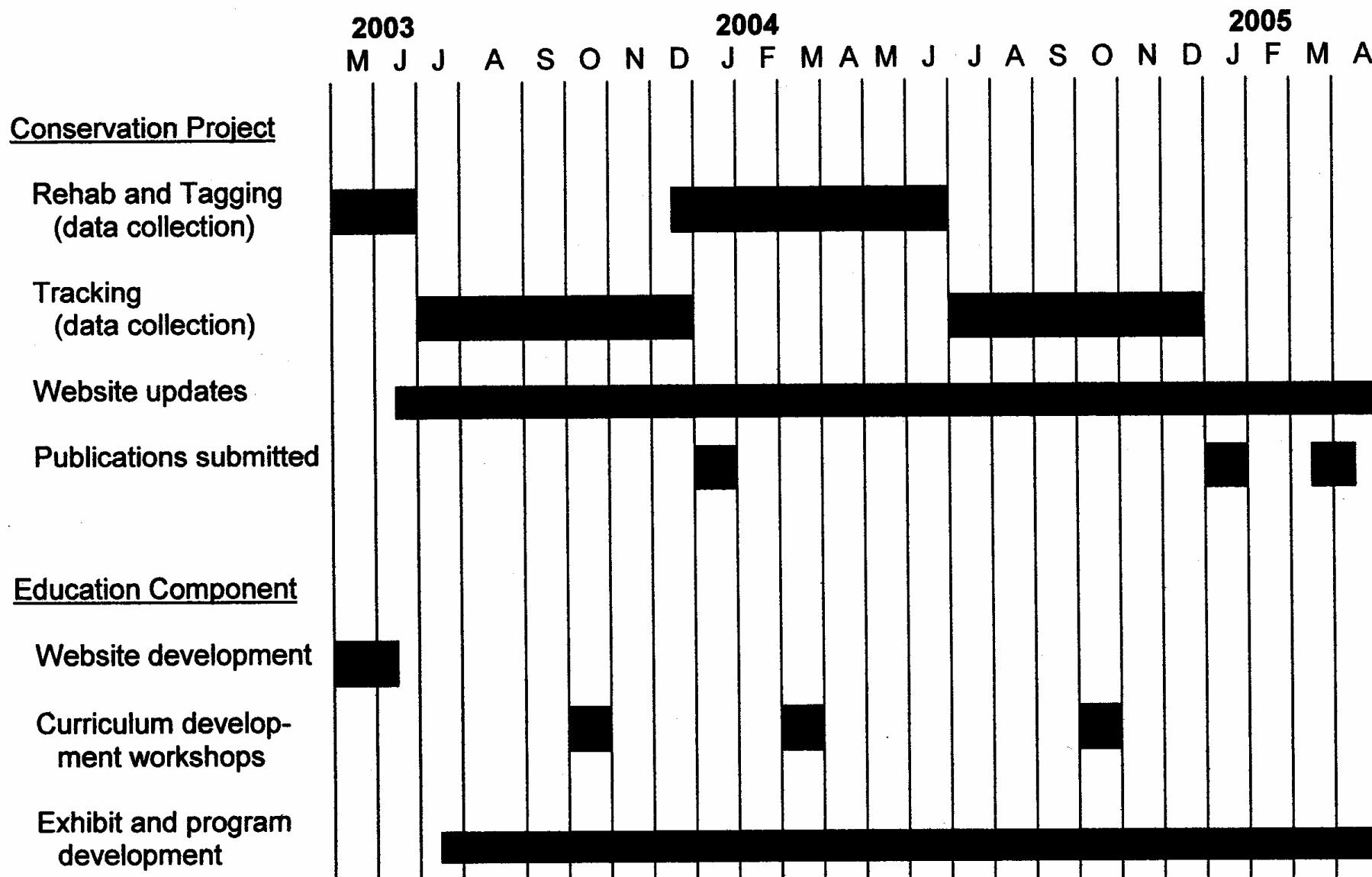
Dr. Craig Harms, DVM, Ph.D., and Diplomate of the American College of Zoological Medicine is a Research Assistant Professor at NCSU/CVM, specializing in aquatic animal health. Dr. Harms has extensive experience rehabilitating sea turtles at the NCA and the Topsail Turtle Hospital. He is lead author on the only study examining clinical pathology values for rehabilitating sea turtles. Dr. Harms will provide medical care, determine when each turtle is releasable, attach transmitters, and assist with data analysis and publications. (26 days total.)

##### Matthew H. Godfrey. Ph.D.. NCWRC Sea Turtle Program Coordinator. Project Investigator

Dr. Matthew Godfrey earned his Ph.D. and M.Sc. degrees in Zoology from the University of Toronto. As the NCWRC Sea Turtle Program Coordinator, he is responsible for coordinating the sea turtle management and conservation program in NC. Dr. Godfrey has over 10 years of experience with marine turtles. He co-founded the Society for Research, Rehabilitation and Reintroduction of Wild Animal Species (CEPER), Bahia, Brazil. Dr. Godfrey is the lead author of eight peer-reviewed publications, and co-author of nine peer-reviewed publications on sea turtle biology and conservation. In addition, Dr. Godfrey is co-author of a book chapter on nesting behavior and loggerhead hatchling development. He has presented numerous papers and posters at scientific meetings. Dr. Godfrey, will tag and attach transmitters to each turtle, coordinate the releases, assist with data analysis and publications. ( 13 days total. )

# Schedule of Completion

May 1, 2003 - April 30, 2005



# **Zoological Society of San Diego**

San Diego, California

Project Type: Research

IMLS Award: \$41,344

Match: \$60,080

Total Project: \$101,424

Museum Budget: \$148,715,945

## 2003 IMLS CONSERVATION PROJECT SUPPORT

### NARRATIVE QUESTIONS -CONSERVATION PROJECT

#### ***Conservation Management of the Critically Endangered Anegada Iguana, Cyclura pinguis: Genetics of Captive and Wild Populations***

##### **1. What is the design of the project?**

Collection of studbook information and management of breeding programs and pedigrees is a crucial part of successfully maintaining and enhancing living collections. The importance of population management has been recognized by IMLS and others through support for the development of quantitative approaches to establishing genetic and demographic databases, as well as tools for their analysis and application to conservation of viable collections. Management of captive populations through studbook data depends on assumptions regarding the relatedness of individuals that may enter the population with unknown parents. These include the founders of a population, i.e., those animals that were wild born and constitute the basis for genetic variation in the captive population. It is also possible to manage populations based on information regarding kinship among founder individuals. However, this is seldom known. The major goal of this proposal is to develop an informed basis for evaluating kinship of founder individuals for a captive collection of a highly endangered species (the Anegada iguana, *Cyclura pinguis*) based on genetic variation in nuclear microsatellite markers.

Microsatellites are stretches of short repeat motifs of two to four nucleotides (bases of DNA) that may vary in length as a result of the number of repeat motifs. Bounded by less variable sequences, the length variation in microsatellites may be assessed through amplification of microsatellite loci using the polymerase chain reaction (PCR). The key to the successful application of microsatellite analysis involves the number of microsatellite loci studied and the combined variation of all of the examined loci. We propose to develop a high resolution system for inferring kinship through analysis of 20 polymorphic microsatellite loci identified by screening a large number of candidate loci from a DNA library enriched for microsatellite sequences. Essential to the success of this effort is an adequate sampling of the source population, especially including unrelated individuals and individuals known to be related.

For several years, we have been collecting blood samples from the wild population of the Anegada iguana, an opportunity that arose as a result of our participation in a headstarting program to bolster the highly endangered wild population<sup>1</sup>. This work has resulted in an archive of blood samples representing 65 randomly related individuals and 86 known clutchmates (full or half-siblings). These samples represent eight different nests spanning four nesting seasons (clutch sizes of 7, 7, 8, 12, 13, 13, 13, and 13 individuals). A quantitative probability analysis of these samples compared to the six potential founders currently in our captive collection and their four offspring will allow key inferences about the relatedness of the captive collection to be made, and will guide future management decisions as the initial nucleus expands over time.

Empirical studies of kinship of founders have been undertaken for relatively few species. Notable examples include the California condor<sup>2</sup>, the Guam rail<sup>3</sup>, the Micronesian kingfisher<sup>4</sup>, and the whooping crane<sup>5</sup>. The earlier studies relied on evaluation of variation using multi-locus DNA hybridization probes. However, the most recent of these studies evaluated variation in 13 polymorphic microsatellite loci<sup>5</sup>. We intend to adopt a "Similar approach, but to utilize a larger

number of microsatellite loci and thereby increase standards for data quality .A notable strength of our proposal is extensive sampling of the remaining wild population of the species, an activity that has already taken place with the full cooperation and participation of governments and wildlife agencies. Our reference samples from the wild population, including sizable cohorts of both randomly related individuals and clutchmates, will allow testing of alternative approaches for estimating kinship using microsatellite data. The experimental design proposed here addresses a recognized need to evaluate kinship of founder individuals in order to improve the effectiveness of living collections in meeting conservation goals <sup>5</sup>.

## **2a. What are the proposed conservation methods and why are they conservationally sound?**

We propose to employ the following specific methods to meet our project goals:

- *Construction and screening of a *Cyclura pinguis* DNA microsatellite library.* We will contract for the construction of a microsatellite library for *Cyclura pinguis*. Genetic Identification Services, Inc. has previously provided highly enriched DNA microsatellite libraries for a variety of species to CRES. Such libraries greatly simplify the rapid identification of candidate loci that may be screened for polymorphism. .
- *Development of primers for PCR amplification of candidate microsatellite loci and identification of a minimum of 20 polymorphic loci.* We estimate that 40-60 cloned sequences in the microsatellite library will need to be sequenced to identify 20-30 candidate loci. Candidate loci will be rapidly evaluated for polymorphism by pooling DNA samples from 6-8 individuals. We know from past experience that microsatellite polymorphism is known to be usefully detected using this method.
- *Screening of approximately 65 individuals from the wild population that are reasonably assumed to be randomly related and 86 individuals of the wild population known to be half-sibs or full-sibs because they hatched from the same clutch of eggs.* Analysis of this reference population will allow evaluation of microsatellite allele similarities for clutchmates. Estimates of kinship probability for the founders of the captive population based on microsatellite allele sharing can be compared to the range of values obtained from known clutchmates and the offspring of the captive founders. The samples required to conduct this research are already on hand, having been collected during previous fieldwork and imported with all necessary CITES and ESA permits. The analysis of a minimum of 20 microsatellite loci from 160 individuals corresponds to 3,200 genotype determinations. Estimating 20% oversampling for repeat analyses, 3,840 genotypes determinations will be made. Given the short run time required for the capillary DNA analyzer for microsatellite genotyping and the ability to run multiple microsatellite amplification reaction products in a single capillary simultaneously, the estimated amount of work can readily be accomplished by a technician within a one year time frame.
- *Analysis of microsatellite variation and determination of pairwise genetic similarities in the founders of the captive population of the *Anegada iguanas*.* We will genotype all captive individuals (six potential founders and their four offspring) and evaluate the extent of allele sharing among them. We will employ published methods for estimating kinship probabilities. Several models and algorithms are available <sup>6-9</sup>. Empirical testing of kinship estimates will benefit from our access to samples of randomly identified individuals and clutchmates from the wild population <sup>5</sup>.

- Studbook management of Anegada iguanas: construction of alternative scenarios and evaluation of implications for population management. Estimation of kinship based upon microsatellite allele data are strongly influenced by assumptions incorporated into the estimation models<sup>5</sup>. The nature of our reference sample population, with its cohorts of randomly-related individuals and eight independent sets of clutchmates, will allow us to explore founder kinship based upon the output parameters of estimation algorithms incorporating differing assumptions<sup>2,9</sup> in accord with known demographic and ecological parameters for Anegada iguanas in the wild. Alternate scenarios for kinship relationships of founder animals will be produced and evaluated for their implications for ongoing population management. Intuitively, we recognize that if the founders are closely related, then the amount of genetic diversity that can be managed and maintained by the captive population is more limited than would be feasible for a population founded by less related individuals. Alternatively, if the captive population represents a reasonable sampling of the wild population, population management of Anegada iguanas can continue to address achievable goals for retention of genetic variation based on information derived from examining genetic variation in the source population. The potential benefits and impacts to the wild population from future genetic exchanges with the captive population can thereby be objectively assessed based on quantitative information.

### **3. What is the object(s), historic structure(s), or specimen(s) that is the focus of this project?**

The focus of the proposed project is the Anegada iguana, *Cyclura pinguis*. With fewer than 200 individuals remaining, this species is one of the most critically endangered lizards in the world, and ranks among the highest conservation priorities of both the American Zoo and Aquarium Association (AZA) Rock Iguana Species Survival Plan (SSP) and the IUCN Iguana Specialist Group<sup>10,11</sup>. Of the eight species of Caribbean rock iguanas, the Anegada iguana is the oldest and most genetically unique<sup>12,13</sup>. The San Diego Zoo has the only individuals of this species outside the British Virgin Islands, and the only captive Anegada iguanas of breeding age anywhere in the world. These six adults (3.3) were relinquished by a private breeder in 2000 to the U.S. Fish and Wildlife Service, and placed with CRES on the recommendation of the British Virgin Islands National Parks Trust and the AZA Lizard Advisory Group. Genetic studies and captive propagation have been identified as two priority conservation activities for this species in the guiding document, *West Indian Iguanas: Status Survey and Conservation Action Plan*, published by the IUCN Iguana Specialist Group<sup>10</sup>.

This proposal seeks to conduct in-depth genetic analyses to determine relatedness among the six Anegada iguanas that may serve as potential founders for a U.S.-based captive population. To accomplish this, we will utilize blood samples representing 65 randomly related individuals and 86 known siblings that have already been collected from the wild population during Zoological Society-funded field studies in 1997-2001<sup>1</sup>. The Anegada iguana serves as a flagship species in the Zoological Society's reptile collection. These animals are prominently displayed in an outdoor 2,475 ft<sup>2</sup> naturalistic enclosure, with full-color graphics panels that detail the plight of Caribbean iguanas and the Society's conservation efforts on their behalf. Our long-term commitment to conservation of this species in both captivity and in the wild is emblematic of the mission of CRES, "to acquire, share, and apply knowledge vital to the conservation of animals, plants, and habitats worldwide."

#### **4. How does the project relate to your museum's ongoing conservation activities?**

Caribbean iguanas in general and the Anegada iguana in particular have been a conservation focus of our institution for over a decade. Under the umbrella of CRES, the Zoological Society carries out conservation and science programs in over 30 countries worldwide, with identified geographic focus areas in China, South America, the Caribbean Islands, the Pacific Islands, and the southwestern United States. The largest terrestrial vertebrates on the islands they inhabit, the giant rock iguanas of the West Indies constitute the central theme of our Caribbean program. We are actively involved in recovery programs for four of the eight species of rock iguanas, as well as actively managing Cuban, Jamaican, Anegada, and Lesser Antilles iguanas in our captive collection. Since 1997, we have worked with the British Virgin Islands National Parks Trust to develop an iguana head starting program on Anegada, to improve facility enhancement and train local Anegadians in appropriate iguana husbandry and repatriation techniques, survey the wild population and identify key nesting areas, and develop public awareness and environmental education materials. The head of the CRES Applied Conservation Division has served as Co-Chair of the IUCN Iguana Specialist Group since its inception, and is President of the newly founded International Iguana Foundation. Applied Conservation Research Coordinator Tandora Grant currently serves as the studbook keeper and population manager for the AZA Rock Iguana SSP. It is our experience and long-term dedication to this group of animals that led to the decision to place the six Anegada iguanas that are the subject of this proposal into our care.

The proposed work will build on a previously awarded IMLS grant to our primary iguana program collaborator, the Fort Worth Zoo, in 1993 (#IC-30232-93). This grant was instrumental in identifying hybrids of the Grand Cayman iguana and determining appropriate individuals to found the zoo-based Jamaican iguana population as a hedge against extinction in the wild. We are active partners in this effort, maintaining the largest group of captive Jamaican iguanas (3.3) outside their native range. In 2000, the San Diego and Fort Worth Zoos, in collaboration with ten partner zoos, were co-recipients of the AZA International Conservation Award for our work with the Jamaican iguana recovery program. On a conceptual level, we continue to seek innovative methods for improving our ability to successfully manage captive populations from a genetic standpoint<sup>14</sup>. A major goal of the CRES Genetics Division is to apply research approaches and knowledge gained in a zoo setting to a better understanding of species in nature, as well as providing new tools for assessment, monitoring, and conservation management of zoo-based collections.

As an organization, we are deeply committed to conservation, with an approximate annual budget of \$5,691,500 dedicated to our conservation and science programs. The Zoological Society's long-range plan for conservation highlights the linking of on-site and field projects with respect to species management and captive propagation as a key focus area. The proposed research contributes toward this goal by promoting our ability to build a genetically healthy captive population, while at the same time answering important questions about genetic variation in the wild population and in the captive cohort of juveniles currently being head started on Anegada. Only when these critical questions have been answered can we help effectively manage the dwindling wild population and make progress toward the AZA Lizard Advisory Group's Regional Collection Plan goal of a genetically healthy population of 25.25 Anegada iguanas in U.S. institutions.

## **5. What are the anticipated benefits of this project?**

In the broadest sense, our work will benefit the zoo community at large by advancing standards for professionalism in carrying out scientifically-based management of our living collections to insure that they remain genetically healthy over the long term. Our work will provide a direct demonstration of the benefits of applying the most recent advances in genetic technology toward endangered species management. Specifically, this project will be of immediate benefit to our institution by enhancing our ability to appropriately manage the critically endangered Anegada iguana in captivity. Results of the proposed studies will provide a more sound justification than currently exists for the need or lack thereof to remove additional animals from the wild population. In addition, establishment of a genetically healthy captive population in the U.S. will provide an essential safety net against catastrophic extinction in the wild. Generic-level genetic studies have shown that the extinction of the Anegada iguana would have a greater impact on loss of genetic diversity within the genus as a whole ( 16% loss) than the disappearance of any other taxon within the group <sup>13</sup>. The Anegada iguana has undergone an 80% decline in numbers since the late 1960s, making it the most endangered animal in the British Virgin Islands today <sup>15</sup>. Because these iguanas are important seed dispersers for many endemic plants, their loss has serious consequences for the ecosystems they inhabit. Given the precarious status of the wild population, there is no doubt that scientifically-guided genetic management of this species can have a significant impact on its future survival.

At the close of the project, we will publish our data regarding the microsatellite diversity of Anegada iguanas in scientific journals. The identified microsatellite loci and the primers used for their amplification will be publicly available and deposited in GenBank. Reports to the British Virgin Islands National Parks Trust, the AZA Rock Iguana SSP, and the IUCN Iguana Specialist Group will be prepared and distributed. Results of the kinship analysis will be made available to the studbook keeper and population manager, and the impacts of these findings assessed for management of the captive population. Accordingly, revised information for the studbook made available through the kinship studies proposed here will form the basis of a new masterplan for management of the captive population of this species. Finally, results of the project will be disseminated to the general public via our institutional publication *Zoonooz*, distributed to 250,000 member households monthly, as well as the Zoological Society's website ( [www .sandiegozoo.org/conservation](http://www.sandiegozoo.org/conservation)).

## **6. How will the applicant ensure that ongoing museum functions are not inhibited by these project activities?**

All but two of the Anegada iguanas are housed off -exhibit at CRES in a dedicated greenhouse research facility (1500 ft<sup>2</sup>). The two individuals that are currently on display are tractable animals that can be easily sampled outside of zoo operating hours. Samples from the wild population have already been collected as part of past Zoological Society-funded fieldwork on this species in the wild. CRES maintains a large, fully equipped genetics laboratory in which analyses such as those proposed here are routinely carried out. This laboratory contains all necessary materials for PCR amplification, including an Applied Biosystems 3100 Capillary Gel Electrophoresis apparatus with Genescan software for genotyping microsatellites and outputting data suitable for the proposed kinship analysis. A full-time research laboratory technician will be hired to carry out the proposed studies. Given the availability of dedicated facilities and



personnel, neither the sample collections nor the analyses proposed here will have a negative impact on our ongoing research and education functions.

## **7. How does the project budget support the project goals and activities?**

The majority of the requested funding will go toward one year of full-time support for a laboratory technician to carry out the proposed genetic analyses (\$29,350). This work is labor intensive and requires a dedicated staff person to complete. The technician will receive ample support and guidance from the other Zoological Society staff members who will participate on the project (resumes attached). We are also requesting \$2,000 of our total \$6,300 supply budget from IMLS. This funding will help cover the laboratory supplies and software required to complete the genetic work. Finally, \$10,000 is requested for the development of a microsatellite library for *Cyclura pinguis*, without which the proposed work would not be possible within a one-year time frame. In terms of both time and cost, it will be most efficient to contract an outside laboratory to develop the library .

## **8. What are the qualifications and responsibilities of the project personnel?**

An IMLS-supported technician will be hired who will devote 100% time to the project (position description attached). Under the guidance of CRES Genetics Division Head Dr. Oliver Ryder, the laboratory technician will be responsible for developing primers for PCR amplification and of candidate microsatellite loci, and screening DNA samples from wild and captive iguanas. The two postdoctoral fellows and four technicians who currently staff the Genetics Division will be available to provide additional guidance and support.

Applied Conservation Division Head Allison Alberts and Genetics Division Head Oliver Ryder will devote 15% and 10% time to the project, respectively, as advisors. Drs. Alberts and Ryder are active members of the AZA Lizard and Small Population Management Advisory Groups, as well as the IUCN Iguana and Conservation Breeding Specialist Groups, placing them in an ideal position to serve as liaisons to zoo colleagues and the international conservation community for this project. As adjunct Professors of Biology at the University of California, San Diego, and San Diego State University , respectively, Drs. Ryder and Alberts have access to a broad array of resources associated with an academic community engaged in related studies.

CRES Applied Conservation Division postdoctoral fellow Glenn Gerber, who collected the blood samples to be used in the proposed studies, will devote 15% time to the project. Dr. Gerber, who has worked extensively with this species in the wild, including the preparation of a species recovery and conservation management plan, will continue to interact on a regular basis with our in-country partners, the British Virgin Islands National Parks Trust. Finally, rock iguana studbook keeper/population manager Tandora Grant will devote 25% time to the project, assisting in the evaluation of microsatellite variation and estimation of kinship probabilities in the founder population.

### Schedule of Completion

[illegible]

# **University of California, Davis Arboretum**

Davis, California

Project Type: Detailed Condition Survey

IMLS Education Award: \$10,000

Total Grant Award: \$46,392

Match: \$48, 111

Total Project: \$94,503

Museum Budget: \$687,707

\$36,392 to conduct a detailed condition survey of the oak collection, including environmental conditions and status of individual specimens. \$10,000 to develop an interpretive sign system for the oak collection that will provide general information on the collection and ongoing conservation practices, explain the specific activities of the proposed conservation project as they occur, and relate these activities to conservation in the wild and in the home landscape.

## **NARRATIVE QUESTIONS-EDUCATION COMPONENT**

### **1. WHAT IS THE DESIGN OF THE EDUCATION COMPONENT?**

The proposed education component will consist of an interpretive sign system for the oak collection of the UC Davis Arboretum that will provide general information on the collection and ongoing conservation practices, explain the specific activities of the proposed conservation project as they occur, and relate these activities to conservation in the wild and in the home landscape. Signage will be designed to engage and challenge Arboretum visitors, to enhance the visitor experience, and ultimately to change visitor attitudes and behavior .

The goals of the project are to educate Arboretum visitors on the value of taxonomic collections in public gardens, the importance of conserving plant collections, the specific conservation practices used in botanical gardens and arboreta, and how these methods might be adapted and applied to plants in public and private landscapes. In addition, signs will educate visitors about the threat to oak biodiversity in California posed by the current epidemic of the Sudden Oak Death pathogen, and the roles that botanic gardens and all Californians can play in containing the epidemic.

We will convene an Exhibit Team (consisting of the Education Director, Communications Director, Interpretive Specialist, and exhibit volunteers) to develop a signage program incorporating permanent and changing signs. Sign messages, text and graphics will be developed using an intensive process of prototype generation and formative evaluation (on-site testing of visitor responses to sign mock-ups) developed by UC Davis Arboretum Director Kathleen Socolofsky in her previous position as Education Director at the Desert Botanical Garden in Phoenix (see *Creating a Visitor-Centered Garden*, attached).

Signs will be designed in-house by the Communications Director. Changing signs will be created using adhesive vinyl on moveable panels. Permanent signs will be fabricated with a bonded graphics surface material that incorporates digitally-printed high-resolution graphics. This material, produced by Folia Signage, is an exciting new addition to the exhibit design field. It is UV-, impact-, and graffiti-resistant, fire-retardant, can be cut, drilled, and shaped, and is self-supporting, so does not require a frame or backing panel.

The project will be carried out over a twelve-month period, from May 2003 through April 2004. This schedule will allow us to interpret the activities of the conservation project using a responsive, informal system of changing signs, and to create and install permanent exhibits on more general themes. We estimate that Arboretum staff will spend 848 hours on the project. This includes 120 hours for project planning, 528 hours for exhibit development and testing, 160 hours for graphic design, and 40 hours for installation. We have recently completed a similar interpretive signage project in our new home demonstration garden and have accurate records on time and costs.

We plan to produce four large permanent signs and ten changing signs that will be installed along the main path through the oak grove. Changing signs may also be used to interpret oaks at other locations in the Arboretum, such as the heritage valley oaks that appear as boundary markers on the earliest maps of this area.

The education component is intimately tied to the conservation project; it uses the work of the project as its subject. The education component will transform the conservation project from a minor inconvenience for visitors (equipment, piles of soil, limited access) to a fascinating exhibit on the behind-the-scenes work of botanical gardens, arboreta, and other holders of biological collections. At the same time, it will illuminate the importance and urgency of conserving living collections in general, this oak collection in particular, and plants in the landscape, especially in light of the epidemic threatening California oaks.

## **2. WHAT ARE THE ANTICIPATED BENEFITS OF THIS EDUCATIONAL PROJECT?**

We expect this project to be very well received by our audience. In September and October 2001 we conducted an extensive survey of our audience, using the Drucker Self-Assessment process. More than 4,000 people responded to the survey, and we conducted more than 70 in-depth interviews with representatives of a wide range of customer groups. There was remarkable consensus across groups in their ratings of the improvements they would like to see at the Arboretum. The top two priorities for all groups were to improve the appearance of the gardens and to interpret the collections with educational signs, labels, and exhibits. This project will meet a clear and urgent need for more information about the collections.

We expect that visitors to the oak grove will come away with a greater understanding of the work of a botanical garden and an appreciation for the importance of taxonomic collections for research, teaching, and the preservation of biodiversity. They will learn something about the conservation of living plant collections, and the relationship of museum conservation to plant conservation in the wild and in private gardens.

One of the most important benefits of the signage program will be to educate visitors about Sudden Oak Death, the disease that has killed hundreds of thousands of wild oaks in California and continues to spread unabated. Humans have been implicated in the spread of the disease as they transport soil, plants, or firewood from infected areas. The disease has not yet been detected in this county, but has in two adjacent counties. Our educational efforts may help slow the spread of the disease by encouraging visitors to recognize and report the symptoms in infected trees and to avoid transporting contaminated materials.

This project will also benefit the Arboretum. An audience that understands the value of scientific collections, and the distinction between a botanical garden and a park, is an important ally. Particularly in these difficult economic times, it is advantageous to museums to cultivate advocates in the community, and this project should increase the Arboretum's visibility and utility, and help us carry out our role as a living classroom and laboratory.

A discussion of the project and reproductions of the signs will be published in the Arboretum's quarterly Review. The support of IMLS will be acknowledged on each of the signs and in the publication. The project will also be disseminated through the Arboretum's docents, who will be trained to incorporate the project into their guided tours.

We expect to continue to use the changing sign system developed for this project to interpret conservation activities in the Arboretum, as well as other seasonal or short-lived features of interest to visitors. The permanent signs in the oak grove will last for years with regular maintenance.

## **3. HOW DOES THE PROJECT BUDGET SUPPORT THE EDUCATION COMPONENT GOALS AND OBJECTIVES?**

The project budget was developed by determining the activities necessary to develop and implement a signage program for the oak collection, and identifying the labor, supplies, equipment, and services necessary to carry out each activity. Labor costs were determined by estimating the amount of time needed for each activity, assigning specific staff or volunteers to each task, and applying the hourly rates of the person(s) assigned. We completed a similar project in our new home demonstration garden in 2001, so we had accurate and recent records of time and costs. Material costs were determined by actual quotes from suppliers.

We believe that the estimated project costs are reasonable and appropriate to the scope of the project. Many museums produce signage "from the top down," by allowing scientists or curators to write sign text and professional designers to create the signs. In practice, such signs are frequently ignored by visitors or ineffective at conveying the intended message. Using formative evaluation and testing to evaluate visitor responses during the exhibit development process requires a greater initial investment of time but results in a vastly more successful product.

We will include volunteers in the exhibit development process both to keep costs down and because they can effectively represent the visitor perspective and bring a broad range of experiences and interests to the process. Relative to traditional materials (fiberglass embedment, porcelain enamel), the Folia material we will use for the signs is exceptionally durable, flexible, and inexpensive. Because it does not require a backing panel it can be mounted on a simple pedestal, further reducing costs.

#### **4. WHAT ARE THE QUALIFICATIONS AND RESPONSIBILITIES OF THE PROJECT PERSONNEL?**

Carmia Feldman, Education Director, will have the overall responsibility for this project. She will convene the Exhibit Team and lead the exhibit planning, design, and testing process. She holds a Master of Science degree in Ecology and is a doctoral candidate in Science Education at UC Davis. Her area of specialization is informal science education at public gardens. Her expertise in the subject matter and in teaching methodologies and theories of learning make her participation in this project essential.

Diane Cary, Communications Director, will participate in the exhibit development process, create the final graphic design for the signs, and manage the production and installation of the exhibits. She holds a Master of Education degree with a specialization in Nonformal and Community Education, and is an experienced writer and graphic artist. Using an in-house graphic designer is cost effective and allows us to test multiple versions of sign mock-ups with visitors, in order to maximize the signs' ability to attract and hold visitor attention and convey key messages.

## **Weatherspoon Art Museum**

Greensboro, North Carolina

Project Type: Treatment

IMLS Education Award: \$4,247

Total Grant Award: \$49,711

Match: \$52,896

Total Project: \$102,608

Museum Budget: \$1,283,303

\$34,289 to treat 18 paintings by the modernist painter, Gregory Ivy (1904-1985), the founder of Weatherspoon and the individual most responsible for its institutional philosophy. \$4,247 to develop two public programs, an interpretive gallery guide, and docent training in conjunction with the conservation treatment of Ivy's paintings.

## Narrative Questions

### **1. What is the design of the education component?**

The Weatherspoon Art Museum seeks \$4247 for two public programs, an interpretive gallery guide, and docent training in conjunction with the conservation treatment of works of art by Gregory Ivy. The goal of the education component is to provide information to our visitors on the conservation of paintings and works on paper in general and on the treatment of Ivy's works specifically.

The initial education activity will be a docent training session, which will consist of a lecture by Ruth Barach Cox, painting conservator. The lecture will prepare docents to discuss with visitors the issues of conservation, the processes being used, and the Ivy collection itself. The docent training will take place prior to the opening of the exhibition and will be supplemented with research materials on the artist.

For visitors who do not receive information by way of a docent-led tour, we will also create a full-color, tri-folded interpretive gallery guide to accompany the Ivy exhibition. The free guide will specifically address the issues of conservation, the techniques used, and images of works before and after treatment so that the guide will be of use after the exhibition. The guide will be designed and produced prior to the exhibition opening and will be available in limited supplies to other exhibition venues. The guide is not intended to replace the more in-depth exhibition catalog. Instead it will be designed as an introduction to the conservation itself and will include easily accessible reference information.

Lastly, two public programs will be offered to specifically address conservation and the Ivy collection. Conservator Jane Sugarman will lead a full-day workshop on paper conservation. The workshop will include a slide lecture citing examples from the Ivy collection and provide an opportunity for participants to use what they learn in examining their own works on paper. The workshop will be open to the public, though registration will be required and will include a minimal cost for lunch. Participants will be invited to bring works on paper for discussion and examination. Ruth Barach Cox will also provide a public lecture addressing the conservation of Ivy's paintings. Like the conservation workshop, the lecture will coincide with the Ivy exhibition so that visitors will be able to make a direct connection to the work on view. The lecture will be free of charge.

The education component will be supervised by Ann Grimaldi, Weatherspoon curator of education. Approximately 5% of her time will be allocated to this project. Consultants for the project will include conservators Ruth Barach Cox and Jane Sugarman. In addition to their allocated time on conservation treatment, approximately 12 and 30 hours respectively will be spent in preparation for these public programs. Additional museum staff will include a UNCG student assistant at 10% of his/her time during the academic year. Preparation for the education component will begin in Fall 2003 with activities implemented in late 2004 and 2005, in accordance with the museum's timeframe for conservation and exhibition of the Ivy collection.



An interpretive gallery guide will be created for the education component of this project. One thousand full-color, tri-folded guides will be produced and offered in limited quantities to other venues exhibiting the Ivy collection. In addition, a postcard promoting the public programs on conservation will be created in-house and mailed to Weatherspoon members.

Since the conservation of the paintings and works of paper will be done off-site, visitors will see little evidence of the conservation in progress. Because of this, we have an opportunity to discuss by way of tours, lectures, publications, and the treated works themselves, what visitors rarely see in an art museum. The Ivy works represent an integral part of in the history of the Weatherspoon and our mission.

## **2. What are the anticipated benefits of this educational project?**

The Weatherspoon recognizes that many of its visitors are first time viewers of modern art. Whether for college students, community members, or school children, programs are designed to provide information in a manner that is accessible and personally meaningful. Because the Ivy conservation project will happen off-site and away from visitors, we feel that it is imperative that we take steps to explain, document, and show the process. In so doing, we hope to 1) inform visitors on what conservation is and what conservators do and 2) discuss issues of conserving modern works of art and 3) provide visitors with another way to approach works of art. We feel that programs and publications, which aim to inform and elicit response, have the long- term benefit of empowering visitors. Our ongoing goal is to provide tools for visitors to make connections to modern and contemporary works of art. There are no current plans to continue this project beyond the Ivy exhibition though gallery guides will be available to other venues for the exhibition.

## **3. How does the project budget support the education component goals and objectives?**

Project expenses were determined on current rates for lectures, travel expenses, and the designing and printing of gallery guides. The costs are reasonable given similar types of education activities we present. The project cash-match will consist of staff support in organizing and promoting the activities, preparing materials, and training docents.

To maximize the outcomes of docent training, it is recommended that the docent lecture with the conservator be scheduled toward the end of the conservation treatment in preparation for tours. All other activities will take place after the works have been conserved and will be concurrent with the Ivy exhibition

## **4. What are the qualifications and responsibilities of the project personnel?**

Curator of education, Ann Grimaldi, is responsible for directing the museum's education programs including docent training, public programming, and the writing of interpretive' materials for school and family groups. She has over nine years of museum education experience and holds a Master of Education degree from Springfield College. She has been at the Weatherspoon Art Museum since 2001, and was assistant director of education at the Worcester Art Museum previously.

Conservators Ruth Barach Cox and Jane Sugannan will lead a docent talk/public lecture and public conservation workshop, respectively, in conjunction with the Ivy conservation project and exhibition. Ruth Barach Cox received her Master of Science in Art Conservation from the Winterthur Museum/University of Delaware Program in 1987, specializing in painting. Since 1989, she has been in private practice in Raleigh, NC, and has done recent conservation work for the Weatherspoon. Jane Sugarman received her Master of Science in Conservation from the Winterthur Museum/University of Delaware Program in 1986. She has been a paper conservator in private practice in Greensboro, NC since 1988 and has also done conservation work for the Weatherspoon.

Clerical support for the project will be provided by a museum approved graduate student assistant from the UNCG Art department. The assistant position is offered for an academic year and involves up to twenty hours per week in the education department.

## **Oregon Zoo (Sample Education Component)**

Portland, Oregon

Project Type: Environmental Improvements

IMLS Education Award: \$9,997

Total Grant Award: \$50,960

Match: \$52,289

Total Project: \$103,249

Museum Budget: \$20,510,609

\$40,963 to install a rubberized "foot-friendly" flooring system in the Zoo's indoor Asian elephant facility to help improve elephant foot care. The Zoo will also conduct a short-term study of elephant behavior on concrete versus rubberized surfaces to demonstrate any behavioral changes and/or flooring preferences. \$9,997 to update an existing educational display incorporating data from this project and add part-time interpretive staff in the elephant viewing room to discuss the flooring project and elephant foot care with visitors.

**2003 Conservation Project Support****Environmental Improvement Project: Foot-Friendly Elephant Flooring****Education Component Narrative****1. WHAT IS THE DESIGN OF THE EDUCATION COMPONENT?**

Oregon Zoo design services and education staff plan to upgrade existing interpretive information provided to Zoo visitors on the topic of elephant foot care. Two primary activities will be supported by an education component grant of \$10,000: 1) creation of an updated interpretive display related to elephant's feet and the new "foot-friendly" flooring project, and 2) hire interpretive staff to discuss this project and elephant foot care with visitors

The current display in the Zoo's indoor elephant viewing room (adjacent to the "Front Room," see Appendix II) is aging, and does not discuss the effectiveness of the soft pliable floor surfaces that the Zoo has been using to minimize foot care problems with the elephant her. The existing display case would be renovated, and the interpretive materials would be rewritten to include this topic in the display. In addition, samples of the flooring types that the Zoo has experimented with would be displayed close-up for visitors to examine.

The Zoo requests \$2,400 funding to renovate the existing casework for the elephant foot care display. The renovation would include refinishing of the existing display case, copywriting to upgrade the current interpretive text to include information on pliable floor surfaces, and reproduction of interpretive panels for the display.

The Zoo's Asian elephant exhibit is one of the most popular destinations for Zoo visitors. The Zoo plans to take advantage of the new elephant flooring project to hire part-time interpretive staff to talk with visitors and utilize the new display materials in the elephant "Front Room." Education component funding (\$7,597) would enable the Zoo to hire and train exhibit interpreters to be stationed in the elephant "Front Room" for a total of 778 hours during busy holiday and weekend periods between October 2003 through June 2004. The Zoo is currently creating a lockable storage area in the Front Room that will conveniently house rolling carts, biofacts, elephant foot care tools and other materials for use by interpretive staff. These teaching aids, some of which are large and bulky, are currently stored elsewhere on Zoo grounds and are under-utilized.

The Zoo's goal is to bring awareness of the importance of new research and techniques in caring for elephants in captivity. The Oregon Zoo has been a leader in research on Asian elephants. That research is ongoing. This refurbished display and additional interpretive staff will provide our visitors with current information on the Zoo's work to improve care for elephants in captivity. Staff time: Pat Kaczmarek, Design Coordinator, 20 hours; David Kato, Senior Graphic Designer 40 hours; Ivory Gray, Management Technician, 20 hours; Roger Yerke, Education Programs Manager, 20 hours.

Schedule: The storage area will be completed during 2002 and is not included in the proposed scope of work. The upgrades to the display would be coordinated with the installation of the new flooring surface. Renovations would take place in July and August of 2003, with a completion date of October 2003 for final installation of interpretive graphics and flooring samples. Part-time interpretive staff will be hired to start work at the elephant exhibit in October 2003 through June 2004.

The renovated display in the Oregon Zoo's elephant viewing room will focus on elephant foot care. The display and interpretive staff would share information, photo and artifacts that describe:

- variations in elephant activity in the wild as compared to captive environments
- the anatomy of elephant feet
- foot cleaning techniques and benefits
- tools and special sandals that are employed to maintain healthy feet in captive elephants
- Zoo efforts to assess the behavioral and physiological benefits of pliable, yielding floor surfaces on captive elephants
- information on the composition and application of new pliable surfaces (Intracorp/Familian International's "Natural Path" product) funded by IMLS.

## **2. WHAT ARE THE ANTICIPATED BENEFITS OF THIS EDUCATIONAL PROJECT?**

There is growing public concern about the quality of care being afforded to animals in captivity. Zoos in the United States have been researching animal care issues and have made many applied research discoveries that have had significant impacts on the types of care provided to their living collections. The Oregon Zoo has been a leader in these kinds of research, adding to the body of knowledge in the zoo profession about the effects of animal enrichment, diet, exercise programs and physical environments.

Our educational program supports the Zoo mission "to inspire our community to create a better future for wildlife." Zoo educators and exhibits strive to raise public awareness of an appreciation for the applied research that is ongoing at the Zoo, and the ways that the research has resulted in better animal care practices. The renovation of the elephant foot care display in our elephant viewing room is an opportunity to bring this research to a majority of Zoo visitors. Oregon Zoo's elephant exhibit is one of the most popular and 8% of our 1.3 million visitors report this as their favorite exhibit.

According to the results of exit surveys of Oregon Zoo visitors, our guests are best able to recall new information acquired during their visit if it is something they were told. Not only do they remember information better when it comes from a Zoo staff member, visitors often cite their interaction with a member of our staff as among the most enjoyable part of their entire Zoo visit. In recognition of this, the Zoo's education division coordinates a two-pronged effort to make this type of interaction possible. A volunteer-based Animal Talker program provides trained docents at popular Zoo exhibits and a Sidewalk Naturalist program places education staff at exhibits that require more extensive interpretation.

The hiring, training and scheduling of a Sidewalk Naturalist in the elephant viewing room will enhance the level of interpretation currently available to visitors to this exhibit. The presence of an interpreter in the public area will help our visitors to understand the new flooring project, the Zoo's daily elephant routines and to more fully understand the efforts of keepers as visitors see them working with elephants; trimming footpads, conducting training sessions and other procedures.

## **3. HOW DOES THE PROJECT BUDGET SUPPORT THE EDUCATION COMPONENT GOALS AND OBJECTIVES?**

Costs for the interpretive display upgrade are based on estimates for the copywriting, interpretive panel fabrication, artifact mounting and case refinishing. Costs are based on estimates from reliable suppliers.

Project costs include the expense of renovating and upgrading the interpretive materials in the Oregon Zoo elephant viewing room's display on elephant foot care. Design services staff routinely work on this kind of interpretive project, and are familiar with the materials and timeline required to fabricate and install an interpretive display that will function well under the high visitor frequency that is typical at the Zoo.

Interpretive staff costs are based on prevailing wages paid for part-time interpretive "Staff by the Zoo's education services division. The Zoo's education division annually recruits and hires more than 50 part-time staff to work in a variety of education programs- including the on-grounds Sidewalk Naturalist program. Sidewalk Naturalists are paid at the rate of \$9 to \$10 per hour. Individuals hired for work in the elephant viewing room will work on weekends and holidays when the Zoo is more heavily visited.

The Zoo's in-kind match is based on projected salaries, wages, and fringe benefits for current staff in the Zoo's design services and education divisions.

#### **4. WHAT ARE THE QUALIFICATIONS AND RESPONSIBILITIES OF THE PROJECT PERSONNEL?**

Pat Kaczmarek has been the Design Coordinator at the Oregon Zoo for three years. One of her first projects at the zoo was to renovate the elephant viewing room. The budget allowed for physical improvements to the space, but did not provide an opportunity to renovate the existing interpretive materials, or enhance them with information on current research on elephant foot care.

Her previous experience is in environmental and exhibit design for Anderson Kryger, Inc. and the Oregon Historical Society in Portland Oregon, where she worked as an exhibit designer and coordinator. She was a senior exhibit designer at the California Academy of Sciences in San Francisco for five years, previous to moving to the Portland area in 1993.

Ms. Kaczmarek will coordinate the research, writing and design components of the interpretive display, and monitor the budget and schedule.

Mr. Roger Yerke has been with the Oregon Zoo since 1978 and serves as Education Programs Manager. His relevant experience includes over 20 years of design, development, implementation, management and evaluation of formal and informal science education programs. Mr. Yerke led the development of the Sidewalk Naturalist program and oversees an extensive array of on-grounds and off-site education programs offered by the Zoo. He will coordinate the integration of elephant flooring project and foot care information into the training of the part-time Sidewalk Naturalist hired for this activity and will oversee the budget and schedule.